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DEPARTMENT OF THE ARMY FIELD MANUAL

**105-MM HOWITZER
M2-SERIES
TOWED**



**HEADQUARTERS, DEPARTMENT OF THE ARMY
DECEMBER 1960**



FIELD MANUAL

No. 6-75

HEADQUARTERS,
DEPARTMENT OF THE ARMY
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105-MM HOWITZER M2-SERIES TOWED

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CHAPTER 1

GENERAL

1. Purpose and Scope

a. This manual is a guide to assist commanders and chiefs of sections in developing the sections of towed 105-mm howitzer firing batteries into teams that will operate effectively in battle. This manual includes individual duties in section drill, firing, and preparation for traveling to include helicopter transporting, inspection and maintenance drills, tests and adjustments for sighting and fire control equipment, and methods for the destruction and decontamination of equipment. The material presented herein is applicable without modification to both nuclear and nonnuclear warfare.

b. Users of this manual are encouraged to submit recommended changes or comments to improve the manual. Comments should be keyed to the specific page, paragraph, and line of the text in which change is recommended. Reasons should be provided for each comment to insure understanding and complete evaluation. Comments should be forwarded direct to U.S. Army Artillery and Missile School, Fort Sill, Okla.

2. Definitions and Terms

a. Cannon. A weapon, larger than small arms that throws its projectile by the use of an explosive. This includes guns, howitzers, and mortars.

b. Gun. A cannon above .30 caliber (length 30 times the diameter of the bore) with a low angle of fire and a high muzzle velocity.

c. Howitzer. A cannon with a medium length barrel, a high angle of fire, and a medium muzzle velocity (fig. 1).

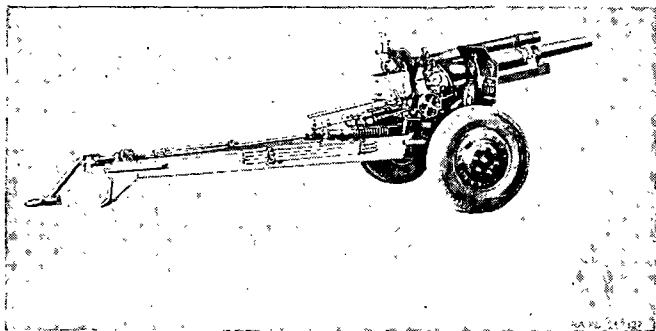


Figure 1. The 105-mm howitzer.

d. Service of the Piece. Operation and maintenance of a weapon or other equipment by its crew.

e. Section. In this manual, the term "section" is used to designate *only* the personnel required to serve one weapon and the equipment prescribed by a table of organization and equipment (TOE).

f. Piece. In this manual, the term "piece" applies to the howitzer being operated by the section; e.g., TO THE REAR OF THE PIECE, FALL IN.

g. Coupled. A piece is coupled when it is attached to its prime mover and all braking and lighting connections are in place.

h. Uncoupled. A piece is uncoupled when it is detached from its prime mover.

i. Front. For the purposes of conducting drills prescribed herein, the front, howitzer coupled, is the direction in which the prime mover is headed; howitzer uncoupled, it is the direction in which the muzzle points. For determining the left or right of the howitzer itself, coupled or uncoupled, the front is the direction in which the muzzle points.

j. Right (Left). The right (left) of one facing to the front.

k. In Battery. A tube (barrel) in battery is a gun tube fully returned on its cradle from recoil.

3. References

Publications applicable to the 105-mm howitzer, towed, are listed in appendix I.

CHAPTER 2

ORGANIZATION

4. Composition of the Section

a. The howitzer section consists of—

- (1) A chief of section (CS).
- (2) A gunner (G).
- (3) An assistant gunner (1).
- (4) Five cannoneers, numbered from 2 to 6. No. 1 is the assistant gunner as shown in (3) above.
- (5) A prime mover driver (D).

b. Section equipment is listed in TOE's and SNL's appropriate to the weapon and unit (fig. 2).

5. General Duties of Personnel

a. *Chief of Section.* The chief of section (CS) is the commander of the section. He is responsible for—

- (1) The proper training for personnel.
- (2) The efficiency of the section.
- (3) The performance of duties listed under section drill, duties in firing, testing and adjustment of sighting and fire control equipment, and inspection and maintenance of all section equipment, especially the howitzer with its prime mover.
- (4) Safety.
- (5) Preparation of field fortification for pro-

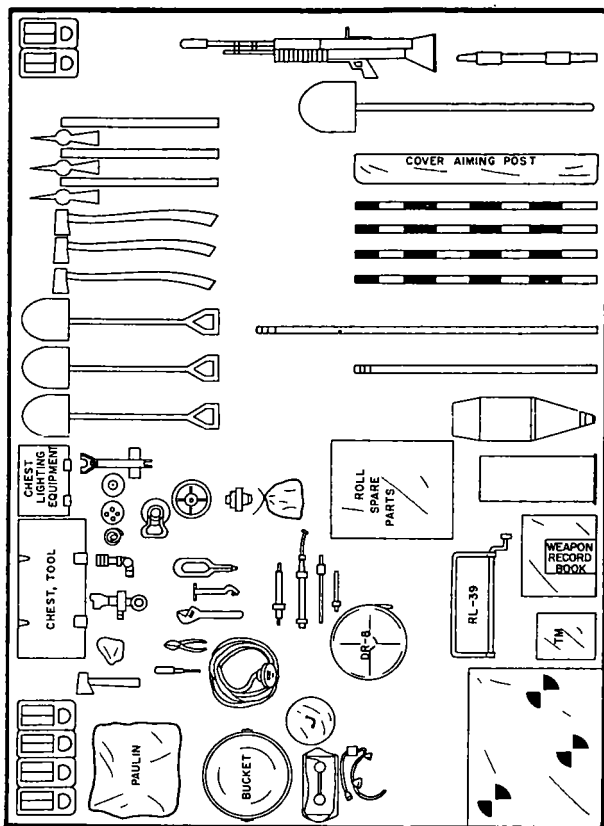


Figure 2. Section equipment, 105-mm howitzer.

tection of personnel, equipment, and ammunition.

- (6) Camouflage discipline and chemical, biological, and radiological defense discipline.
- (7) Maintenance of the gun book.
- (8) Improvement and policing of the section area.

b. Gunner. The gunner assists the chief of section in the duties outlined in *a* above. Specific duties are outlined in later chapters.

c. Cannoneers. Cannoneers perform duties listed in later chapters and any other duties outlined by the chief of section.

d. Driver. The driver's primary duties are driving and maintaining the prime mover. He remains with the prime mover unless assigned other duties. He should be trained in the fundamentals of section drill so he will be able to work as a cannoneer when required.

CHAPTER 3

SECTION DRILL

Section I. GENERAL

6. Objective

The objective of section drill is efficiency: maximum precision coupled with high speed.

7. Instructions

a. Except for commands and reports, section drill should be conducted in silence. The section must be drilled until reactions to commands are rapid and automatic. To achieve the objective stated in paragraph 6 and to prevent personnel injury and equipment damage, the drills prescribed in this manual must be followed.

b. Members of the section must be impressed with the importance of reporting promptly to the chief of section any errors discovered either before or after the command to fire has been given. The errors are then corrected and reported to the battery executive immediately.

c. The battery executive, or his representative, should supervise the drill to insure uniformity and efficiency.

d. During each training period, duties should be rotated so each man can perform all the duties within the section. Any battery overhead personnel, not assigned specific duties during drill periods, should be trained in the fundamentals of section drill to

become capable of functioning with a section if required.

Section II. PRELIMINARY COMMANDS AND FORMATIONS

8. Forming the Section

a. To Fall In. The chief of section takes his post. On the command FALL IN, the section forms in a single rank, at close interval, centered on the chief of section at a distance of 3 paces. The gunner is always at the right and the driver at the left of the rank. The numbered cannoneers fall in numerical sequence from right to left. The chief of section may indicate in his preparatory command the place and direction most suitable to form the section for a particular situation. At the first formation for a drill or exercise, the caution, "As a section," preceeds the command. The commands may be FALL IN; or 1. IN FRONT (REAR) OF YOUR PIECE, 2. FALL IN. Cannoneers face the direction of fire unless told otherwise; 1. ON THE ROAD FACING THE PARK, 2. FALL IN; or 1. ON THE LEFT (RIGHT) OF THE PIECE, 2. FALL IN. Cannoneers face the piece, unless told otherwise.

Note. On any of these commands, the section moves at double time and forms at close interval, at attention, guiding on the gunner.

b. To Call Off. With the section in formation, at the command CALL OFF, all personnel except the gunner execute eyes right. The section then sounds off in sequence: "gunner," "1," "2," "3," "4," "5," "6," "driver." As each man calls out his designation, he turns his head smartly to the front.

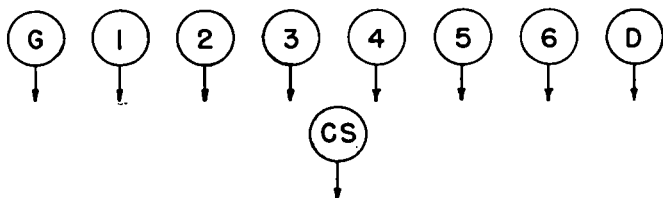


Figure 3. Section in formation.

9. Posts

The command is 1. CANNONEERS, 2. POSTS. The command is general and is applicable whether the section is in or out of ranks, at halt, or marching. The command is executed at double time and terminated at the position of attention.

a. Piece Coupled. The section moves to posts shown in figure 7. ALL personnel face the front and are alined 2 feet outside the prime mover, gunner and even-numbered cannoneers on the right, odd numbers on the left. Numbers 5 and 6 even with the rear of the prime mover. The gunner and remaining cannoneers cover on them, in order, at normal interval. The driver and chief of section are even with the front bumper on the left and right sides, respectively.

b. Piece Uncoupled, March Ordered. The section moves to posts shown in figure 8. All personnel face the front and are alined 2 feet outside the wheels. Gunner is even with the hub of the left wheel, and the even-numbered cannoneers are covered on him at a normal interval. The number 1 man is even with the hub of the right wheel, and the odd-numbered cannoneers are covered on him at a normal interval. The chief of section positions himself where he can best control the section.

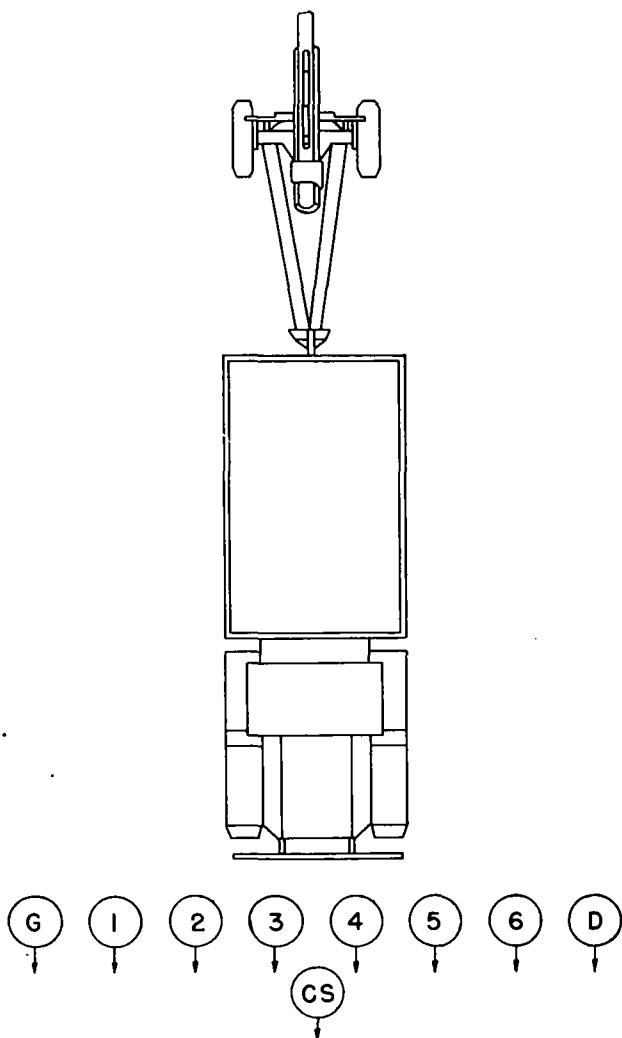


Figure 4. Section formed in front of the piece, coupled.

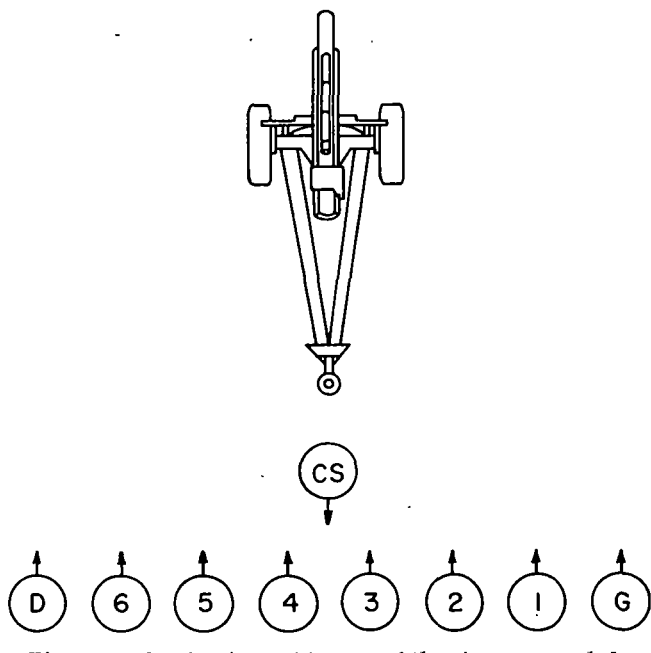


Figure 5. Section formed in rear of the piece, uncoupled.

c. Piece Prepared for Action. The section moves to posts as shown in figure 9, with all personnel facing the front, except the chief of section, who faces the executive officer unless the section is drilling independently. Gunner and No. 1 are to the rear and alined with the outside edge of the left and right wheels, respectively. No. 2 stands inside the left trail even with the trail handspike traveling socket. No. 3 is outside and 12 inches away from the left trail dressed on No. 2. No. 4, 5, and 6 form one rank away from and outside the left trail with No. 4 covered on No. 3.

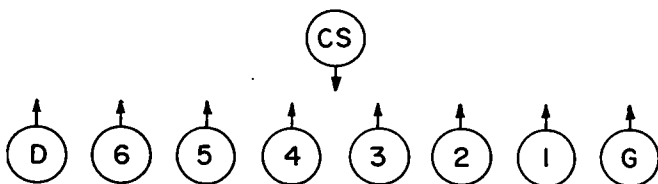
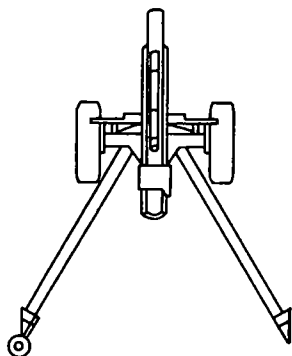


Figure 6. Section formed in rear of the piece, uncoupled, prepared for action.

10. To Change Posts

a. To acquaint the members of the section with all the duties and to lend variety to drill, posts should be changed frequently. With the section *in formation*, the commands are 1. CANNONEERS, CHANGE POSTS, 2. MARCH. 1. SECTION, CHANGE POSTS, 2. MARCH.

b. At the command CANNONEERS, CHANGE POSTS, MARCH, only the numbered cannoneers change posts. On the preparatory command, No. 6 (or the highest numbered cannoneer) takes one step to the

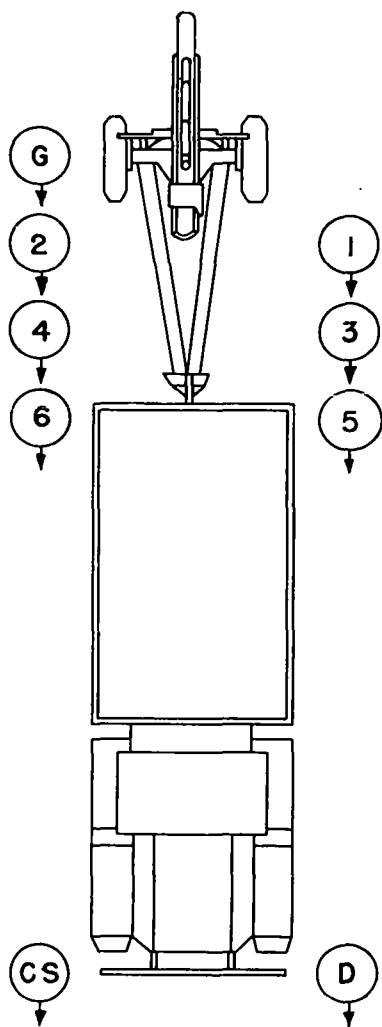


Figure 7. Posts, coupled.

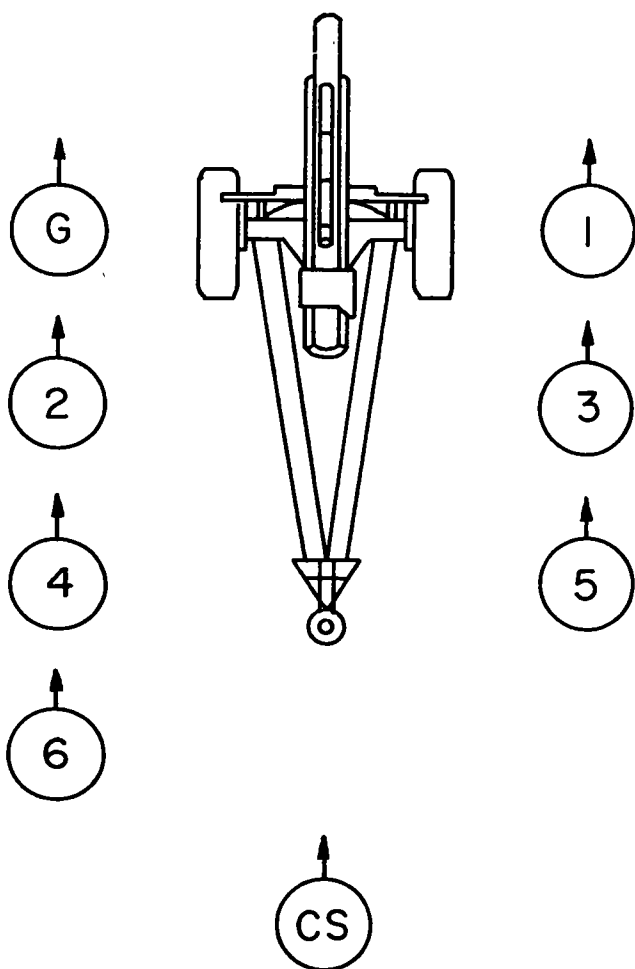


Figure 8. Posts, uncoupled, march ordered.

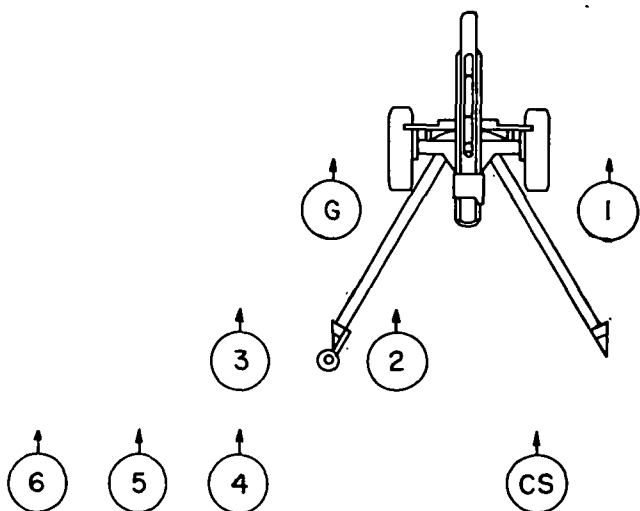


Figure 9. Posts, uncoupled, prepare for action.

rear and executes a right face. On the command of execution, he moves at double time in rear of the section to the post of No. 1. All numbered cannoners take two left steps, placing them at the post of the next higher numbered cannoner.

c. At the preparatory command SECTION, CHANGE POSTS, the driver (or leftmost man) takes one step to the rear and executes a right face. On the command of execution he moves at double time in rear of the section to the gunner's post. The gunner and all other men in line take two left steps as in *b* above.

11. To Mount

a. The commands are 1. PREPARE TO MOUNT, 2. MOUNT; or MOUNT.

b. At the preparatory command in *a* above, the

section moves at a double time to positions shown in figure 7. At the command of execution, all members of the section mount and take seats as shown in figure 10. Each cannoneer is assisted by the man directly behind (or in front in the case of the last man) to insure rapid mounting and to prevent injuries. Before the commander of the vehicle and the driver mount, they verify that the load is properly coupled, that personnel and equipment are aboard, and that the tailgate and safety strap are secure. If any members of the section are to remain dismounted, their designation is announced with the caution "stand fast" between the preparatory command and the command of execution; e.g., 1. PREPARE TO MOUNT, DRIVE STAND FAST, 2. MOUNT.

c. If the command is MOUNT, the section executes without pausing, all that has been prescribed in 6 above.

12. To Dismount

a. The commands are 1. PREPARE TO DISMOUNT, 2. DISMOUNT; or DISMOUNT.

b. At the preparatory command in *a* above, the members of the section stand, if appropriate, and make preparations to dismount quickly. At the command of execution, members of the section jump to the ground and take posts as shown in figure 7.

c. If the command is DISMOUNT, the section executes without pausing all that has been prescribed in *b* above.

13. To Fall Out

a. *At Drill.* When it is desired to give the section a rest from drill or relieve them temporarily from

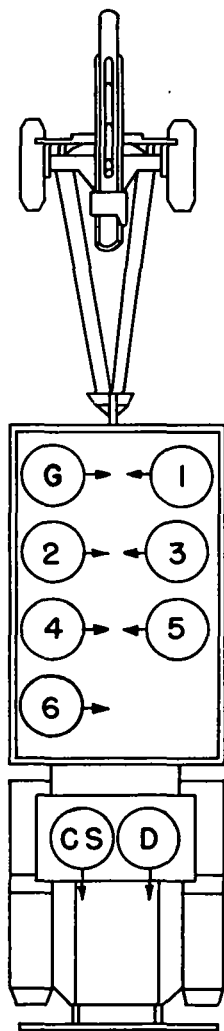


Figure 10. Posts, coupled, mounted in prime mover.

a *formation* or *post*, the command FALL OUT is given. The command may be given at any time and infers that the section is to remain in the vicinity of the drill area.

b. *When Firing.* When firing has been suspended temporarily, but it is desired to have the section remain in the vicinity of the piece, the command FALL OUT is given. The section stands clear of the piece to insure that settings and laying remain undisturbed. During these periods, the chief of section may direct his men to improve the position, to replenish ammunition, or to do other necessary work around the howitzer.

CHAPTER 4

PREPARING THE HOWITZER FOR FIRING AND TRAVELING

Section 1. PREPARATIONS FOR FIRING

14. To Uncouple

The command is UNCOUPLE. At the command, members of the section take positions shown in figure 11 and execute the following:

a. The gunner disconnects the blackout light system from the prime mover. No. 1 removes the blackout light system from the piece and places it in the section chest. The gunner then takes his post to supervise the uncoupling.

b. No. 1, 2, 3, and 6 move to the trail handrails, even-numbered cannoneers on the left, odd-numbered on the right with respect to the tube.

c. No. 4 and 5 go to the muzzle of the piece, set the brakes if directed, and assist by placing their weight on the tube.

d. No. 2 unlatches the pintle and, assisted by No. 1, 3, and 6, lifts the lunette from the pintle.

e. No. 1, 2, 3, 4, 5, and 6 move the piece to the desired location.

f. No. 1, 2, 3, and 6 then lower the trails to the ground. No. 4 and 5 set the left and right handbrakes, respectively.

15. Direction

a. *Action Front.* If the command ACTION

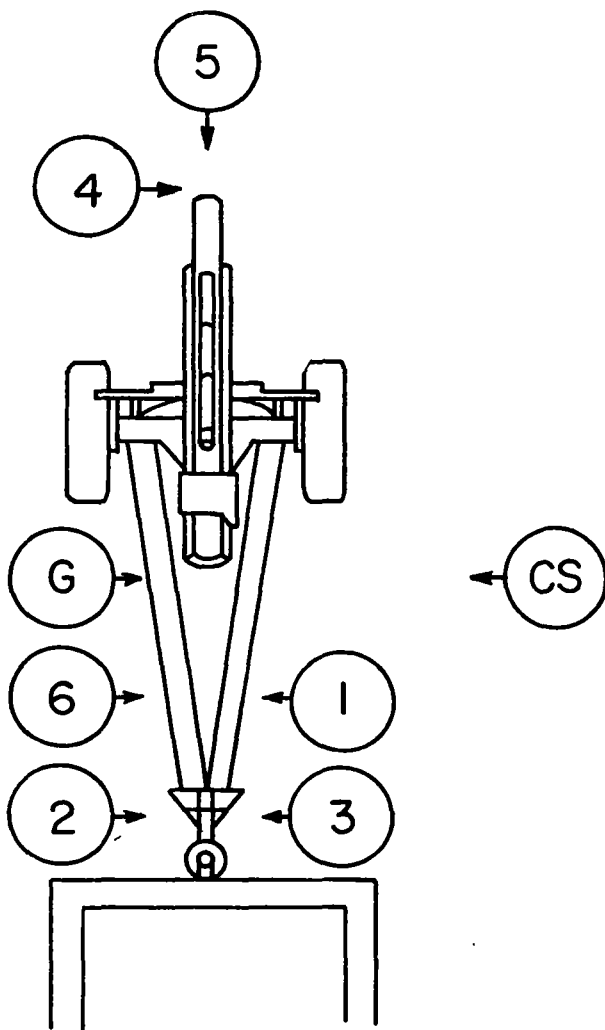


Figure 11. Uncoupling (coupling) the piece.

FRONT is given, number 4 sets the left handbrake and the howitzer is turned 180° in a clockwise direction (par. 2i).

b. Action Right (Left). The command is ACTION RIGHT (LEFT). The movement is executed as in ACTION FRONT, except that after the piece is uncoupled, it is turned 90° in the appropriate direction (par. 2j).

16. Moving the Piece by Hand

a. On the commands: 1. PIECE FORWARD (BACKWARD), 2. MARCH, the following actions are taken:

(1) No. 1 and 3 grasp the right trail handrails and No. 2 and 6 the left.

(2) No. 4 and 5 ride the muzzle to balance the howitzer.

(3) Gunner directs the piece with the lunette.

b. At the command MARCH, all move the gun forward (backward) under the direction of the chief of section (fig. 12). When the piece is being moved up or down steep slopes, numbers 4 and 5 assist by alternately setting and releasing the left and right brakes, permitting the weapon to be pivoted about the alternately braked wheels, moving the howitzer in a zigzag manner.

c. At the command HALT, the piece is stopped and the cannoneers take their posts (par. 9c and fig. 8).

17. Prepare for Action

a. With the howitzer in position uncoupled, the command PREPARE FOR ACTION, is given (fig.

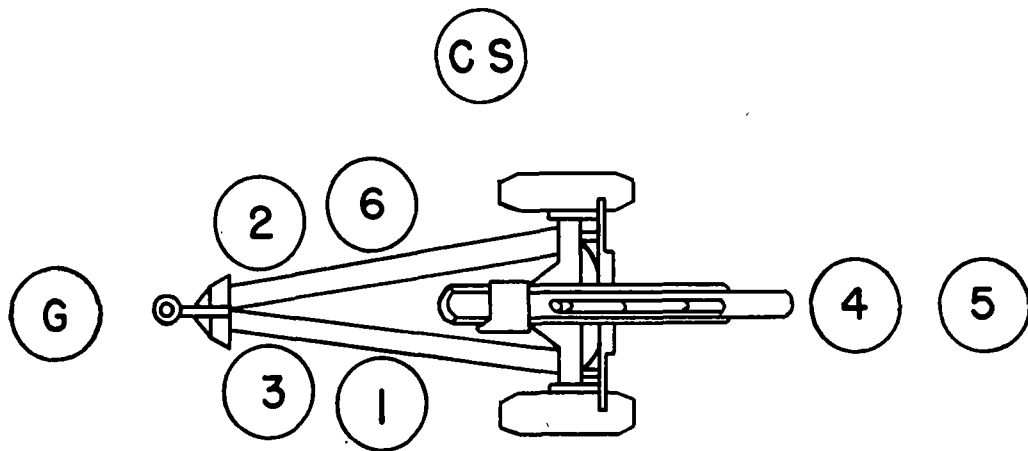


Figure 12. Moving the piece by hand.

Table 1. Duties in Prepare for Action

Sequence	Chief of Section	Gunner	Number 1	Number 2	Number 3	Number 4	Number 5	Number 6
1	Supervises the work of all cannoneers throughout all sequences.			Unlocks trail locking latch	Disengages the drawbar locking shaft and rotates the drawbar 180° to the upward position.	Unlocks and lowers the bottom flap of the shield.		Removes the trail handspike from the traveling position and places it in its socket at the rear of the left trail.
2						Unlocks the left axle lock from the traveling position and locks it in the firing position.	Unlocks the right axle lock from the traveling position and locks it in the firing position.	
3			Lifts and spreads right trail assisted by number 3.	Using the handspike for leverage, assisted by number 6, lifts and spreads the left trail when number 4 calls "spread."	Using the drawbar for leverage, assisted by number 1, lifts and spreads the right trail when number 4 calls "spread."	When he sees that number 5 has the right axle lock unlocked, he calls "spread," informing numbers 1, 2, 3, and 6, that the trails may be spread.		Assists number 2 in lifting and spreading the left trail when number 4 calls "spread."
4		When the left trail is fully spread, locks it in position by inserting the trail locking pin into the forward hole (firing position).	When the right trail is fully spread, locks it in position by inserting the trail locking pin into the forward hole (firing position).	When directed removes the rammer staff from its traveling position, assembles it to the rammer head (bore brush), and assists number 2 in cleaning the breech mechanism, chamber, and bore.	Arranges ammunition and equipment assisted by numbers 4, 5, and 6.	Unfasten the front of the overall cover and fold the front flaps back to the gunner and number 1.		Place the section chest to the left of the gun.
5		Gunner and number 1 together receive the front portion of the overall cover from numbers 4 and 5 and remove the cover to the rear. Number 1 folds cover and places it on the ground to right of the right wheel.					Removes muzzle cover and places it to the right of the right wheel.	Lays telephone wire from his piece to the switching kit.
6		Removes the panoramic telescope from its case and seats it in the telescope mount.	Operates the elevating handwheel to assist number 4 in unlocking the cradle lock.			Unlocks the cradle lock strut, assisted by number 1 operating the elevating handwheel, and locks it in the firing position.	Removes the aiming posts from the traveling position, assembles them and places them to the right of the piece.	Assists number 3 in arranging the ammunition and equipment.
7	Verifies that the recoil mechanism contains the proper amount of oil.	Uncovers the telescope mount leveling vials matches elevation indexes (fine and coarse) on telescope mount; sets index of rotating head at zero; sets deflection at zero; levels mount by centering both bubbles.	Uncovers the range quadrant leveling vials; sets site at 300 and centers bubbles; operates the breech mechanism and examines the breechblock, chamber, and bore, cleaning any parts requiring it (assisted by number 2 when so directed); leaves breech open.			Assists number 3 in arranging the ammunition and equipment.		
8	Verifies that the gun is prepared for action. Reports to executive, "Sir, number (so-and-so) in order," or reports any defects that the section cannot remedy without delay.		Removes the elbow telescope from its case and seats it in its mount when so directed.				Assists number 3 in arranging ammunition and equipment.	

Table II. Duties March Order

Sequence	Chief of Section	Gunner	Number 1	Number 2	Number 3	Number 4	Number 5	Number 6
1	Inspects the piece to insure that it is not loaded. Supervises the work of all members of the section throughout all sequences.	Assists number 4 in locking the cradle locking strut by placing the piece in the center of traverse. Withdraws the left trail locking pin from the forward hole (firing position) and inserts it in the rear hole (traveling position).	Inspects the chamber to see that the gun is unloaded; closes the breech after inspection by the chief of section. Closes cover on range quadrant vials. Assists number 4 in locking cradle locking strut by operating the elevating handwheel. Withdraws the right trail locking pin from the forward hole (firing position) and inserts it in the rear hole (traveling position). Picks up gun cover from the right of the gun and places it over the cradle. Moves to right trail.	Moves to his position at the left trail prepared to assist in closing it.	Moves to his position at the right trail prepared to assist in closing it.	Locks the cradle locking strut in traveling position assisted by the gunner operating the traversing handwheel and number 1 operating the elevating handwheel. Releases the left handbrake.	Releases the right handbrake...	If removed, inserts the trail handspike in its socket in the rear of the left trail. Moves to his position at the left trail prepared to assist in closing it.
2		Fit the overall cover over the breech end of the howitzer fitting the holes of the cover over the traveling lock shaft; leave the cover draped over the cradle.	Assisted by number 3 closes right trail when number 4 calls "close." Verifies that the traveling lock shafts fit into the traveling lock brackets.	Using the handspike for leverage, assisted by number 6, closes the left trail when number 4 calls "close."	Using the drawbar for leverage, assisted by number 1, closes the right trail when number 4 calls "close."	When he sees that gunner and number 1 have finished fitting the holes of the gun cover over the traveling lock shaft, calls "close" to numbers 2, 3, and 6 indicating that the trails may be closed.	Picks up the muzzle cover, and after the tube has been inspected by the chief of section and found cleared, fastens the cover on the muzzle.	Using the handrail for leverage assists number 2 in closing the left trail when number 4 calls "close."
3		Sets the rotating head and deflection of the panoramic telescope at zero. Closes the covers on the telescope mount level vials. Removes telescope from its mount and places it in its case; locks the case.	Removes the elbow telescope, if mounted, and places it in its case.	Locks the trail locking latch after the trails are closed.	Disengages the drawbar locking shaft and rotates the drawbar 180° to the downward position, and reengages the drawbar locking shaft.	Locks left axle lock in traveling position by rotating the crank of the axle lock crank assembly 180° out toward the wheels and engages the lock in the outer hole.	Locks the right axle lock in traveling position by rotating the crank of the axle lock crank assembly 180° out toward the wheels and engages the lock in the outer holes.	Removes the handspike, fastens it in its carrying socket on the left trail. Picks up wire from executive's control station and other wire as directed.
4	Inspects for proper march order specifically the trail lock, cradle traveling locks, cradle locking strut, and handbrakes.	Fit and fasten the breech end of the overall cover-----		Disassembles the rammer staff; removes the rammer (bore brush) and places it in the section chest; fastens the sections of the rammer staff in their brackets onto the left trail, if removed in prepare for action.	Prepares ammunition and equipment for loading in the prime mover, assisted by other members of the section.	Raise and latch the bottom shield flap; secure the overall cover over the forward part of piece.		
5	When operations have been completed reports to the executive "Sir, number (so-and-so) in order," or reports any defects that the section cannot remedy without delay.	Assists the chief of section in supervising the march order.		Assists number 3 in preparing ammunition and equipment for loading in the prime mover.		Assists number 3 in preparing ammunition and equipment for loading in the prime mover.	Retrieves and disassembles the aiming posts, places them in their covers, and fastens them in their brackets on the right trail. Assists number 3.	Assists number 3 in preparing ammunition and equipment for loading in the prime mover.

13). If the command is not given by the battery executive before the weapon moves into position, it is habitually given by the chief of section as the piece is uncoupled.

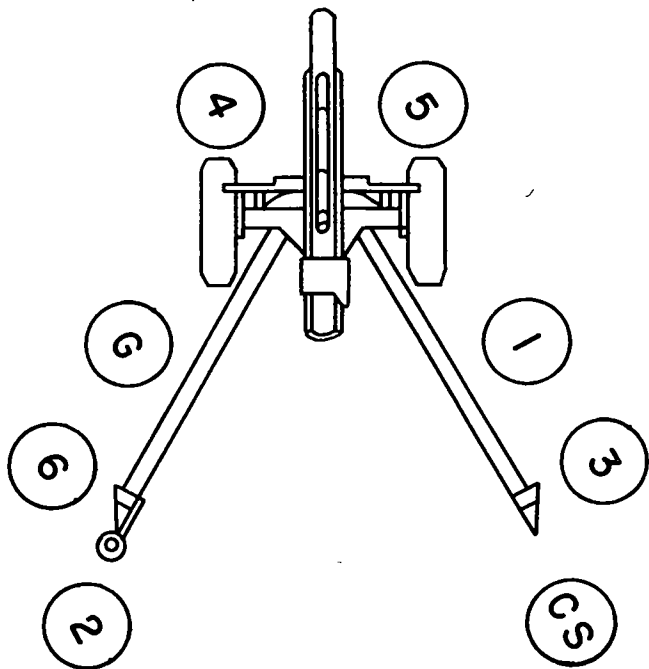


Figure 13. Prepare for action.

b. Individual duties in the execution of the command are shown in table I. On completing the designated duties personnel take posts (fig. 9).

c. The caution DO NOT PREPARE FOR ACTION must be given if the weapon is only to be uncoupled.

Section II. PREPARATIONS FOR TRAVELING

18. March Order

a. To prepare to travel, with the howitzer uncoupled and prepared for action, the command is **MARCH ORDER**. After completion of designated duties, personnel take posts as in figure 8.

b. Individual duties during march order are shown in table II.

19. To Couple

With the piece in position, march ordered, the command is **COUPLE**. The prime mover is positioned by the chief of section. The duties are as follows:

a. No. 5 and 6 lower the tailgate. The section, directed by the chief of section, loads the tools, ammunition, and equipment. No. 5 and 6 raise and fasten the tailgate.

b. No. 1, 2, 3, and 6 move the trail handrails, even-numbered on the left, odd-numbered on the right with respect to the tube (fig. 11).

c. No. 4 and 5 move to the front of the piece and release the left and right handbrakes, respectively, if directed. Otherwise they assist by placing their weight on the tube.

d. The chief of section directs the maneuvering of the prime mover until the pintle is almost over the lunette.

e. No. 1, 2, 3, and 6 raise the trails and place the lunette in the pintle. No. 2 latches and locks the pintle.

f. No. 1 secures the blackout light system to the

muzzle; the gunner connects the cable to the prime mover.

g. As each man completes his duties, he takes his post (fig. 7).

h. The chief of section verifies that the section is in order; checking that the handbrakes are released, the blackout light system connected, and the pintle latched and locked. He then reports, "Number (so-and-so) in order."

Section III. PREPARATION FOR AIRMOBILE OPERATIONS (TYPE A AND B LOADS)

20. General

a. The procedures approved for disassembly and assembly of the 105-mm howitzer for airmobile operations requires 10 persons for the type A load and 15 persons for the type B load. Since only nine men, including the prime mover driver, are assigned to each howitzer section of the 105-mm battery, it is necessary to augment from alternate sections.

b. Certain items of special equipment are required in preparing the howitzer for airmobile movement and for assembly after transport. These items include lifting bars, nylon webbing, and miscellaneous tools.

21. Procedures

a. Disassembly—Type A Load.

- (1) The assistant gunner and the No. 3 cannoneer remove auxiliary shield from the right side of the howitzer while No. 2 and 4 remove the shield from the left side (special tools required for removal of shields are

available in the battery maintenance section) (fig. 14).

- (2) No. 1 man removes the sights and breech-block assembly from the breech recess and places them in section chest.
- (3) No. 6 removes howitzer locking ring and places it in section chest.

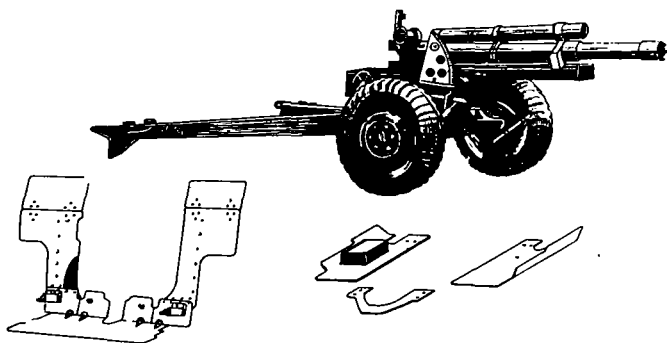


Figure 14. Shields removed (type A or B load).

- (4) The lifting bar is inserted horizontally through the breech recess in the breech ring by No. 2. No. 2, 4, and 6 will carry the portion of bar extending out the left side and No. 1, 3, and 5 will man the right side. The tube is drawn to the rear of the howitzer and the second lifting bar is placed under the forward portion of the tube before it clears the carriage. The two extra cannoneers will man and support the left portion of the bar at the muzzle end while the chief of section and gunner support the right portion.

- (5) The howitzer tube is carried to the assigned helicopter loading point.
- (6) The howitzer carriage is towed or man-handled to its assigned helicopter loading point and trails are closed.
- (7) The chief of section supervises No. 2, 3, 4, and 5 cannoneers in rigging the howitzer carriage for helicopter lift (fig. 15).

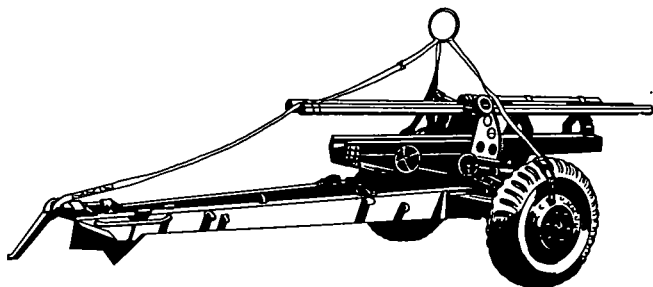


Figure 15. Carriage and recoil mechanism prepared for type A load.

- (a) No. 5 cannoneer holds nylon ring with three straps attached.
- (b) No. 2 cannoneer places chain on left wheel at top center while No. 3 places chain in same position on right wheel.
- (c) No. 5 takes position on the cradle while No. 2, 3, and 4 takes the long strap and slip the loop over the lunette ring and drawbar.
- (d) No. 2 takes the nylon strap on the left side and connects the loop in the end to the clevis attached to the wheel. No. 3

man completes the same operation on the right side.

- (e) No. 4 places a 12-inch block of wood between the equilibrator straps to take the weight off the elevating arcs, places the lifting bars on the carriage between the elevating arcs and the recoil mechanism (length of bars running fore and aft), and straps them on with two adjustable nylon straps which are 3 feet long.
- (f) No. 5 places sight mounts in a position which will not interfere with nylon straps.
- (g) No. 2 and 3 tape straps with masking tape to prevent them from slipping under sight mounts when slack is taken up during helicopter lift.
- (8) The gunner supervises the assistant gunner, No. 6, and one extra cannoneer in rigging the howitzer tube for helicopter lift (fig. 16).

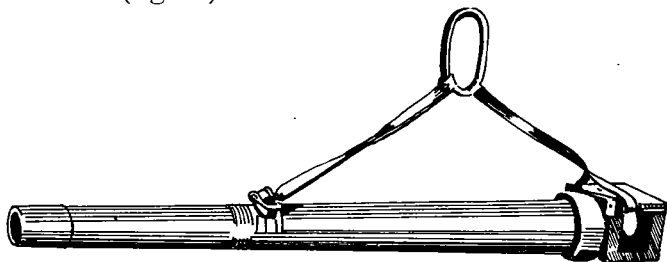


Figure 16. Tube prepared for type A load.

- (a) The No. 6 cannoneer holds the nylon ring with two attached straps.
- (b) One extra cannoneer threads end with large loop through the breech recess, then

passes small end loop through the larger loop to form a slip knot above the breech recess. The assistant gunner runs the other strap around the muzzle end of the tube at the bearing surface located behind the barrel locking ring threads. The extra cannoneer takes a clevis and inserts it on the front strap, placing the loop in the jaws of the clevis, inserts the clevis pin so that it passes through the loop (small), and secures.

b. Reassembly—Type A Load. Procedures outlined in *a* above are executed in reverse order. It is imperative that all mechanisms be scrutinized for possible damage and dirt which may render the weapon unsafe to use.

c. Disassembly—Type B Load.

- (1) Same as *a*(1) and (2) above.
- (2) No. 6 cannoneer removes piston rod outer locking unit.
- (3) Same as *a*(4) above except that six cannoneers from an alternate howitzer section will assist in the removal of the tube and recoil mechanism as a single intact unit. This is accomplished by introducing a third lifting bar and utilizing nylon straps which are wrapped around the tube at the muzzle end and around the recoil mechanism at the center of the piece. The third lifting bar is inserted through the breech for carrying.
- (4) Same as *a*(5) through (8) above except obvious modification of (7)(*e*) (figs. 17 and 18).

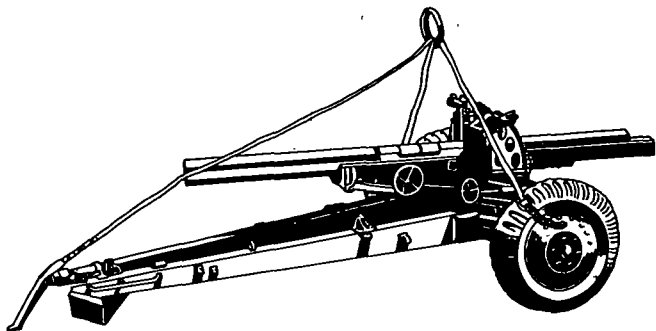


Figure 17. Carriage prepared for type B load.

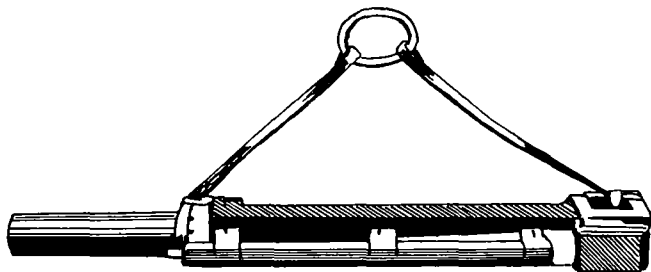


Figure 18. Tube and recoil mechanism prepared for type B load.

d. Reassembly—Type B Load. Procedures outlined in *c* above are executed in reverse order.

e. Hookup Procedure.

- (1) The gunner positions himself in front of carriage and, by signals, directs the helicopter to a hovering position directly over the load. No. 5 places the nylon ring in the helicopter cargo hook. During night hookup an additional cannoneer may be positioned at the right side of the helicopter to relay signals to the gunner.

- (2) After carriage is lifted the gunner and No. 5 man move to the howitzer tube loading point and repeat the hookup process. Section personnel and their equipment are loaded into the helicopter while the tube is being hooked up and are transported to the position area internally while the tube is carried externally.

CHAPTER 5

DUTIES IN FIRING

Section I. INDIRECT LAYING

22. Duties of Individuals

The general instructions given in paragraphs 6 and 7 on the conduct of section drill apply equally to section drill during firing. The duties are outlined in paragraphs 22 through 30.

23. Chief of Section

For indirect laying, the duties are as follows :

a. Lays for Elevation When Gunner's Quadrant Is Used.

- (1) The command **USE GUNNER'S QUADRANT** indicates that the gunner's quadrant is to be used because the range quadrant is inoperative or does not provide the desired accuracy for the mission being fired.
- (2) **A QUADRANT 361.8**, for example, is set on the gunner's quadrant (fig. 19) as follows: The upper edge of the index plate is set opposite the 360 mark of the graduated arc on the quadrant frame and the micrometer on the index arm is turned to read 1.8. Care must be taken to use the same side of the quadrant in setting both the index plate and the micrometer knob.
- (3) The announced quadrant having been set on

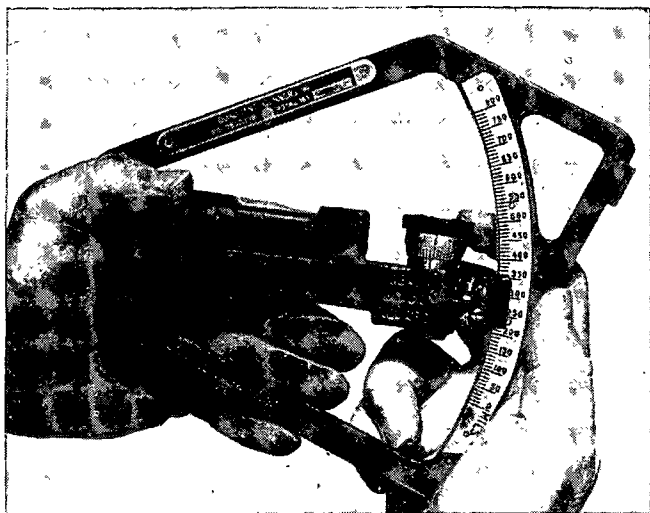


Figure 19. Setting the gunner's quadrant.

the gunner's quadrant, the piece loaded, and the breechblock closed, the gunner's quadrant is set on the quadrant seat leveling plates on top of the breech. The words "line of fire" must be at the bottom of the quadrant with the arrow pointing toward the muzzle. The chief of section must be sure to use the arrow which appears on the same side of the quadrant as the scale which he is using. He stands squarely opposite the side of the quadrant and holds it firmly on the quadrant seat leveling plates parallel to the axis of the bore. *It is important that he take the same position and hold the quadrant in the same manner for each subsequent setting*, so that in each case he will

view the quadrant bubble from the same angle.

- (4) The chief of section then directs No. 1 to elevate or depress the piece until the bubble is centered, being careful that the last motion is in the direction in which it is more difficult to turn the handwheel. The chief of section cautions No. 1 when the bubble is approaching the center, in order that the final centering may be accurate.
- (5) Normally, special and calibration corrections will be added algebraically at the executive officer's command post or fire direction center and simply announced as NO. (so-and-so), QUADRANT (so much).

b. Measures the Quadrant. At the command MEASURE THE QUADRANT, with the piece laid, the chief of section directs No. 1 to center the cross-level bubble, to insure the angle of site scale is set at 300, and, with the elevation knob, center the range quadrant longitudinal-level bubble. The chief of section then reads the quadrant set on the range quadrant scales and announces it as "No. (so-and-so) quadrant (so much)." If the range quadrant is inoperative or known to be inaccurate, the quadrant is measured by placing the gunner's quadrant on the leveling plates on the breech ring where the chief of section, by raising and lowering the index arm and turning the micrometer knob, centers the bubble. He then reports the reading on the gunner's quadrant to the executive.

c. Measures Site to the Mask.

- (1) The command is MEASURE THE MASK.

The chief of section has No. 1 assure that 300 is set on the angle of site scale and center the cross-level bubble. Then, sighting along the lowest element of the bore, he directs the gunner and No. 1 to operate the traversing and elevating mechanism until the line of sight just clears the crest at its highest point in the probable field of fire. He then directs No. 1 to center the longitudinal-level and cross-level bubbles by turning the range quadrant knob. The chief of section reads the site to the mask from the range quadrant scales and reports to the executive, "NO. (so-and-so), SITE (so much), RANGE (so many meters)."

- (2) When the executive announces the minimum quadrant for each charge, the chief of section records it in a notebook and directs No. 1 to chalk the minimum quadrant for each charge to be used on a convenient place on the shield.

d. Indicates the Aiming Point to Gunner. When the executive designates an aiming point, the chief of section will make sure he has properly identified the point and then indicate it to the gunner. If necessary, the chief of section will place the horizontal and vertical hairlines of the panoramic telescope on the designated point.

e. Follows Fire Commands. The chief of section will follow fire commands and will repeat the commands if required.

f. Indicates When the Piece is Ready to Fire. As soon as the gunner calls, "Ready," the chief of sec-

tion will extend his right arm vertically upward, and report orally to the executive, "Number (so-and-so) ready" (fig. 20).

g. Gives the Command to Fire. The chief of section will drop his right arm sharply to his side and command orally: FIRE. He requires the per-

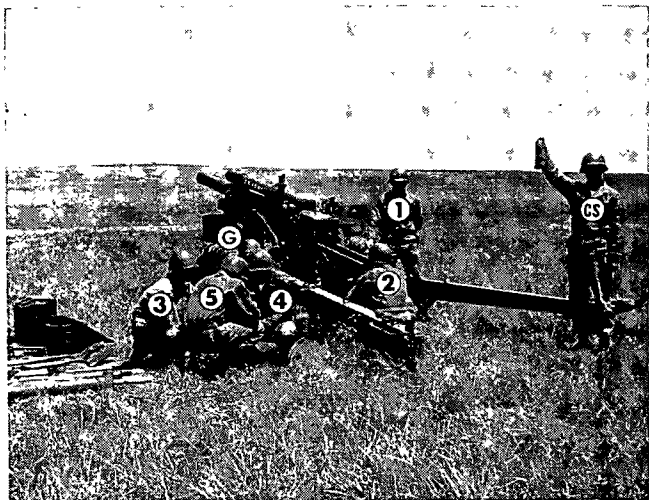


Figure 20. Howitzer loaded and ready to fire.

sonnel stand clear of the piece until it is firmly seated.

h. Reports Mistakes and Incidents in Firing to the Executive. If for any reason a weapon cannot fire, the chief of section reports this to the executive; for example, "No. (so-and-so), misfire." When it is discovered that a round has been fired in error, the chief of section will report it; an example is "No. (so-and-so) fire 40 mils right." If the gunner re-

ports that the aiming posts are out of alinement, the chief of section reports this and requests permission to realine them. Any incident that affects the service of the piece is reported.

i. Conducts Prearranged Fires. When prearranged fires are ordered, the chief of section will fire his section to conform with the prescribed data.

j. Records Basic Data. The chief of section records semipermanent data such as minimum quadrant; aiming points used and their deflections; prearranged fires when section data sheets are not furnished; deflection and quadrant safety limits; date, hour, and number of rounds fired; and calibration and individual piece corrections when appropriate.

k. Observes and Checks Functioning of Materiel. Before the piece is fired, the chief of section assures that a proper amount of recoil oil is in the recoil mechanism, and carefully observes the functioning of the recoil system. He promptly reports to the executive any evidence of malfunctioning (TM 9-325).

l. Assigns Duties When Firing With Reduced Strength. Whenever the personnel of the section serving the piece is reduced in numbers below that indicated in this manual, the chief of section will make redistribution of duties to best facilitate the service of the piece. Understrength units, loss of cadremen, casualties, and various details will necessitate gun section operation with a reduced number of personnel to the extent that it is almost normal for cannoneers to double-up on duties. When a round-the-clock firing is to be rendered, cannoneers

must work in shifts so that provision can be made for relief. Two possible sets of duty *combinations* are—

(1) Five Man Sections: Chief of Section and
Gunner

No. 1 (no other duty)

No. 2 and No. 3

No. 4 and No. 5

No. 6

(2) Four Man Section: Chief of Section and
Gunner

No. 1 (no other duty)

No. 2 and No. 3 (no
other duty)

No. 4, 5, and 6

m. Verifies the Adjustment of the Sighting and Fire Control Equipment. Paragraphs 124 through 131, TM 9-325 give the detailed descriptions of tests and adjustments.

n. Checks All Rounds Prepared for Firing Before They Are Replaced in Their Containers. Insures that all seven powder increments are present in proper numerical order, condition, and lot number. Sees that lot numbers on ammunition and container correspond.

24. Gunner

The duties of the gunner are as follows:

a. Centers the Level Bubbles on the Telescope Mount. This centering is a part of all operations that involve the use of the panoramic telescope except those described later for direct fire, when, in the two-man, two-sight system (pars. 35-39), the

gunner levels the cross-level bubble only. Centering the bubbles and leveling the telescope mount is always done prior to firing (*i* below).

b. Lays the Piece for Direction. The executive commands BATTERY ADJUST, AIMING POINT THIS INSTRUMENT. The gunner identifies the aiming point through the panoramic sight and announces NUMBER (so-and-so) AIMING POINT IDENTIFIED. The executive then commands NUMBER (so-and-so) DEFLECTION (so much). The gunner sets the announced deflection on the panoramic sight by disengaging the throw lever and rotating the head of the sight until the appropriate 100-mil graduation is opposite the index. The remainder of the announced deflection is set on the azimuth micrometer scale. The gunner then commands MUZZLE RIGHT (LEFT) to aline the line of sight with the aiming posts. If the line of sight is within 10 mils, the gunner may use the traversing mechanism to aline the line of sight with the aiming posts. In either case, the gunner must insure that the longitudinal and cross-level bubbles are centered. The gunner then announces NUMBER (so-and-so) READY FOR RECHECK. As additional deflections are announced, the gunner sets them off as described above. When the executive commands NUMBER (so-and-so) IS LAID, the gunner will not disturb the lay of the tube until an aiming point is fixed.

c. Alines Aiming Posts. With the piece laid, as in *b* above, the executive may command AIMING POINT, AIMING POSTS, DEFLECTION 2800, REFER. At this command the gunner sets the pano-

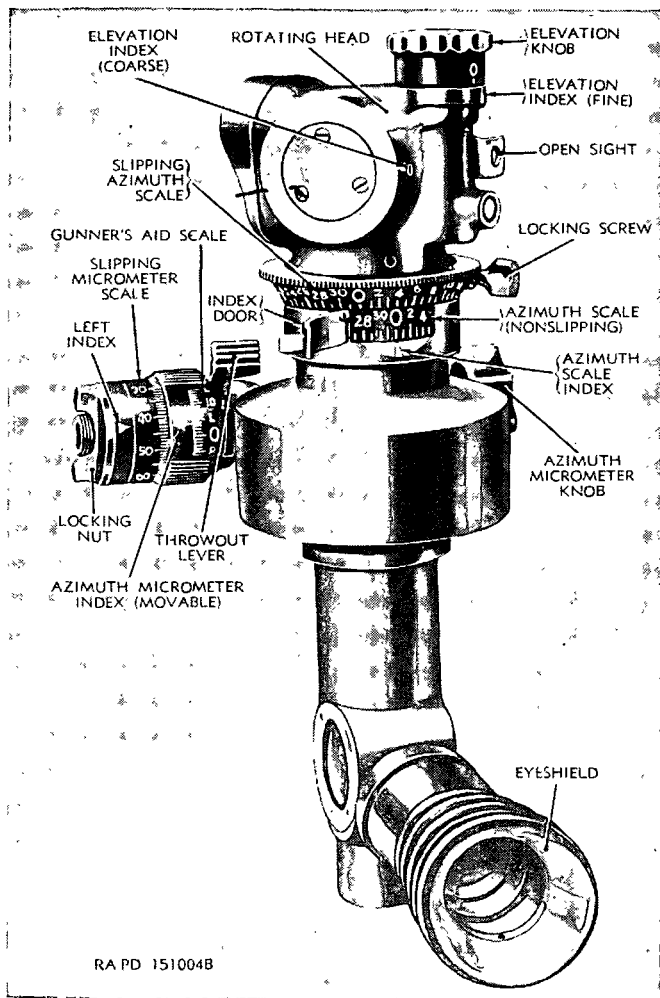


Figure 21. Panoramic telescope M12A7D.

ramic telescope at deflection 2800 and, with hand signals, directs No. 5 in the alinement of the posts with the vertical reticle of the sight (fig. 23). If because of the nature of the terrain the posts cannot be set out at deflection 2800, the gunner turns the azimuth micrometer knob until the slipping azimuth scale is on another even hundred-mil graduation. He

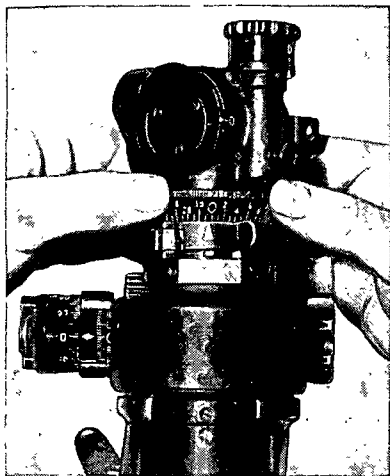


Figure 22. Slipping zero of the slipping azimuth scale to index on door.

alines the posts at this new deflection. The chief of section reports the altered deflection to the executive: "No. (so-and-so) aiming posts at (so many hundred), deflection 2800 in lake (or other reason)." The executive will then command No. (so-and-so), DEFLECTION 2800, REFER. At this command, the gunner loosens the locking screw and moves the slipping azimuth scale to deflection 2800 (fig. 24).

He then tightens the locking screw and verifies the adjustment.

d. Sets a Common Deflection on a Common Aiming Point After the Piece Has Been Laid. The battery having been laid, the executive may command AIMING POINT, CHURCH STEEPLE, REFER. At this command, without moving the tubes,

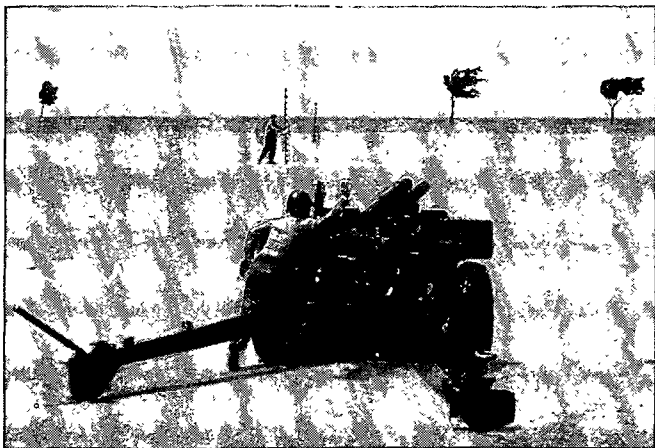


Figure 23. Gunner and No. 5 alining aiming posts.

the gunners of all pieces turn their sights to the aiming point designated and report the deflections to the executive. The executive then commands COMMON DEFLECTION 2800. At this command, each gunner loosens the locking screw and moves the slipping azimuth scale until 2800 is in coincidence with the index on the door. The gunners then unlock the slipping azimuth micrometer scale locking nut and move the slipping azimuth micrometer scale to zero, tighten the locking nut, and

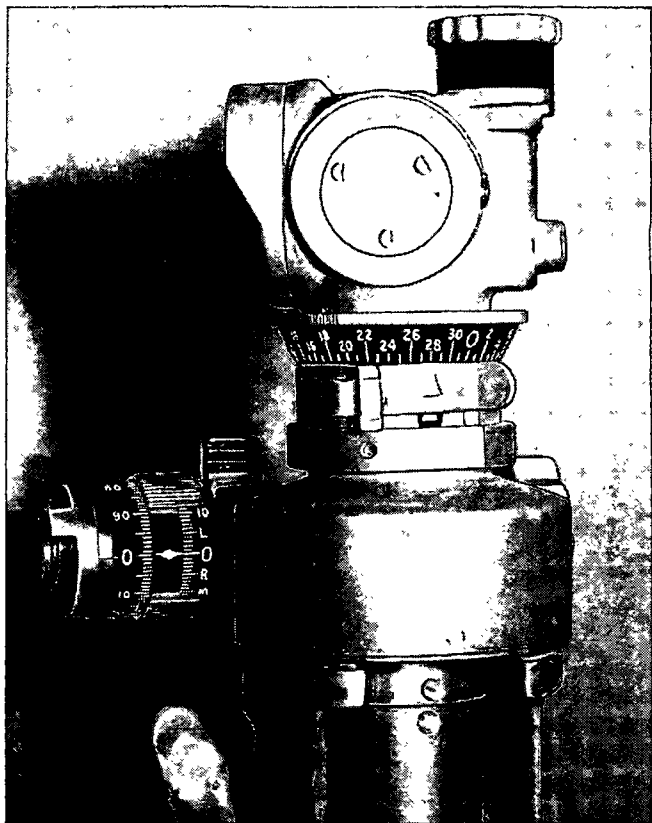


Figure 24. Common deflection 2800.

verify that zero is in coincidence with the index and that line of sight is still on the aiming point.

e. Sets or Changes a Deflection. The command is DEFLECTION (so much). If, for example, the command is DEFLECTION 483, the gunner disengages the throwout lever with his left thumb

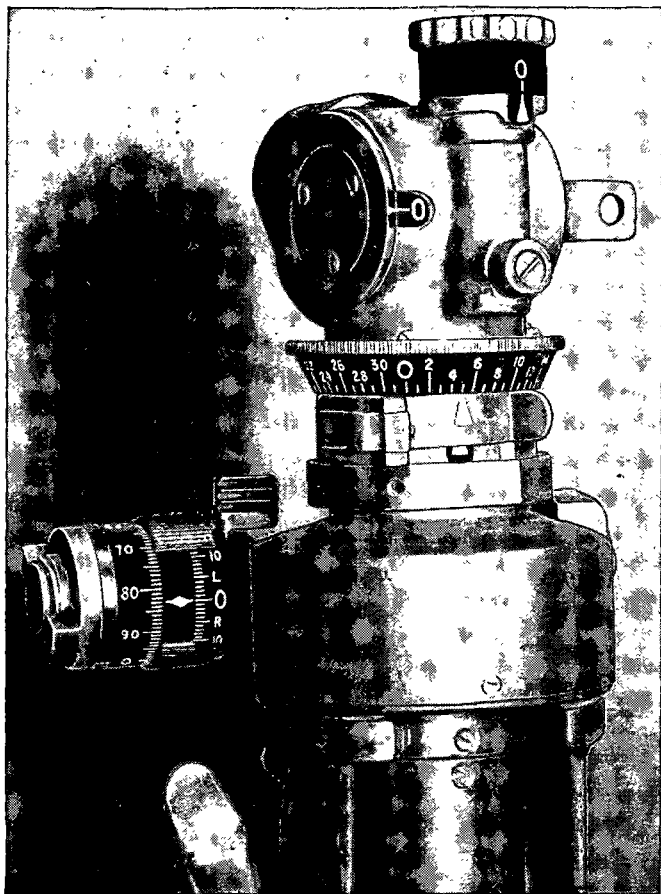


Figure 25. Deflection 483.

and turns the rotating head of the sight to 4 (400). He releases the throwout lever and with his right hand turns off the remaining 83 mils on the micrometer scale (fig. 25). He then traverses the piece until

the vertical reticle is on the aiming post, being careful that the last motion is such as to cause the vertical hair of the telescope to approach the aiming point from the left to take up any lost motion in the mechanism.

f. Applies Individual Piece Corrections for Deflection. These corrections are accomplished by moving the movable azimuth micrometer index the proper amount of direction. For example, the executive announces DEFLECTION 2665, NO. 1 LEFT 10. The gunner on No. 1 howitzer first sets off the announced deflection, then moves the azimuth micrometer index (gunner's aid) left 10 mils. He then resets the announced deflection at the index in its new position. Subsequent deflections which are set on the azimuth micrometer scale will be increased 10 mils automatically. The individual piece correction is left on the gunner's aid until completion of the mission or until a new correction is announced. The new individual piece correction is set off as commanded and is not applied algebraically by the gunner.

g. Refers the Piece. The command from the executive is AIMING POINT THIS INSTRUMENT (or other point), REFER. Without disturbing the lay of the piece, the gunner turns only the sight until, with bubbles level, the vertical reticle is on the point designated. He then reports the deflection to the executive: "No. (so-and-so), deflection (so much)."

h. Makes Correction for Aiming Post Displacement. See paragraph 45.

i. Calls "Ready." After the piece has been laid for direction and No. 1 has called "Set," the gunner

verifies the laying, moves his head clear of the telescope, and calls "Ready" as a signal to the chief of section that the piece is ready to be fired.

25. Number 1

The No. 1 cannoneer is the assistant gunner (par. 4a(3)). A detailed list of his duties follow.

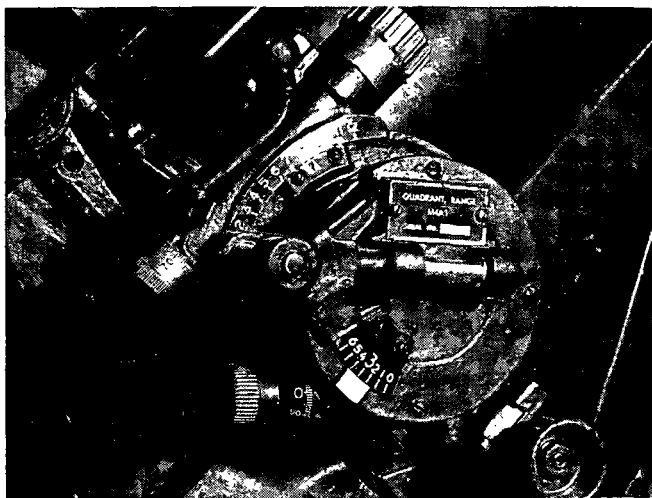


Figure 26. Site 300, elevation 866.

a. Insures that the Angle of Site Scale is Set at 300. No. 1 turns the angle of site knob until the 300 is indicated on a scale graduated in hundreds of mils from 0 to 6; and 0 indicated on a micrometer scale graduated from 0 to 100 mils.

b. Sets the Quadrant. No. 1 turns the range quadrant knob until the announced quadrant is indicated on the scale graduated from minus 100 to plus 1200

and on the micrometer graduated from 0 to 100 mils. The last motion should be in the direction of increasing reading.

c. Lays for Quadrant. No. 1 centers the cross-level bubble and turns the elevating handwheel, to elevate or depress the tube until the longitudinal-level bubble is centered. When centering the bubble, the eye should be directly opposite the bubble. The last motion of the handwheel should be in the direction of the most opposition.

d. Opens and Closes the Breech.

(1) *Opens breech.* No. 1 grasps the breech operating lever handle with his left hand, depresses the handle to release the catch, and draws it toward him and to the rear, opening the breech.

(2) *Closes the breech.* No. 1 grasps the breech operating handle with his left hand and pushes it forward and away from him until the breech is closed and the latch is engaged. When the breech is fully closed the latch is automatically engaged.

e. Calls "Set." As a signal to the chief of section and the gunner that the piece is loaded, breech closed, and the tube laid for quadrant; No. 1 calls "Set."

f. Fires the Piece. At the command and signal FIRE from the chief of section (par. 23g), No. 1 pulls the lanyard with his right hand (fig. 27) and releases it after firing. In case of misfire, instructions in paragraph 82 should be followed.

g. Assists No. 3 in Shifting the Right Trail. When the command MUZZLE RIGHT (LEFT) is given, No. 1 and 3 shift the right trail in the opposite di-

rection until given the signal on command to stop. They then lower the trail to the ground.

26. Number 2

The duties of the No. 2 cannoneer are as follows:

a. Loads the Howitzer. No. 2 steps toward No. 4 with his left foot and grasps the round, with his right hand at the base of the cartridge case and his left

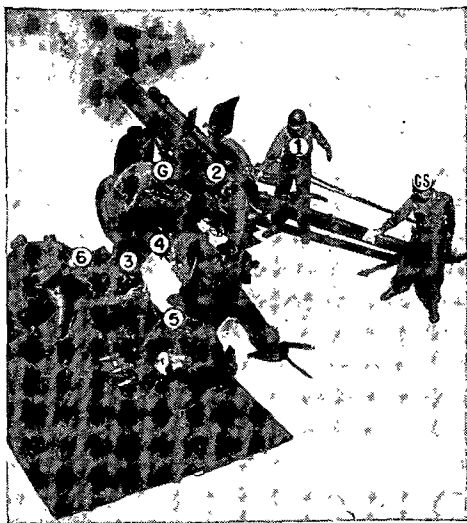


Figure 27. "Number 1 fire."

hand in front of the rotating band (fig. 28). He resumes his position facing front. After quadrant is announced, he inserts the round in the breech and *pushes it home* with his right fist (fig. 29). As a word of caution, if the *fingers* are used to *push the round home* there is a great danger of crushing fingers by the closing breechblock. Be careful to avoid striking

the fuze against any part of the piece and keeping rounds to be loaded out of the path of recoil.

b. Calls Out the Round Number and Quadrant in Volley Fire. To insure firing the correct number of rounds, No. 2 calls out the number of the round and the quadrant as he loads the projectile. On the last round he adds, "Last round." For example, when



Figure 28. Number 2 receives round from number 4.

three rounds are to be fired at quadrant 482 he calls out, "Third and last round, 482." He calls out only loud enough for his section to hear.

c. Assists No. 6 in Shifting Left Trail. On the command MUZZLE RIGHT (LEFT), No. 2 and 6 shift the left trail in the opposite direction so the muzzle will point in the direction commanded.

d. Inspects the Chamber and Bore. After each

round is fired, No. 2 inspects to see that the chamber and bore are free of any residue from the charge. He calls out "Bore clear," only loud enough for his own section to hear.

e. Dispenses With Empty Cartridge Cases. No. 2 stacks empty cartridge cases in rear of the right trail where they will be out of the way of the section.

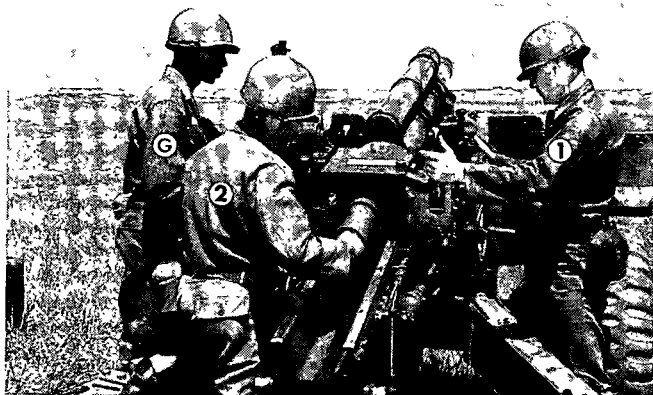


Figure 29. Number 2 loading the piece.

27. Number 3

The duties of the No. 3 cannoneer are as follows:

a. Fuzes or Changes Fuzes of Projectiles. No. 3 removes the fuze or closing plug from the projectile; removes (or replaces) the supplemental charge, if necessary; and screws in the designated fuze. In fuzing or defuzing the shell, only the authorized fuze wrench should be used. VT fuzes should be screwed

in by hand and tightened with fuze wrench M18 using only manual force.

Caution: Do not hammer on the wrench or use an extension handle. If a time fuze is used, No. 3 removes the safety pull-wire from the fuze.

b. Sets the Fuze Using Setter M26 or M28.

- (1) Fuze setter M26 (fig. 30) may be used with TSQM54, TSQM55, MT67, TSQM500, TSQM501, and TSQM520 fuzes. No. 3 seats fuze setter M26 on the fuze by inserting upper lug in the upper recess. He loosens the wingnut on the setter; and sets the announced time on the appropriate time band. He locks the wingnut, places the handle in the horizontal position, and turns counterclockwise (in the direction of increasing reading) until he feels a stop and hears a click. He then raises the handle to the vertical position, removes setter, and verifies the setting by visual inspection.
- (2) Fuze setter M28 (only) should be used to set fuze VT M513-series. No. 3 places the stationary lug on the setter into the top recess of the fuze and pushes down until the setter is fully seated on the fuze. No. 2 sets the fuze by placing the announced setting on the fuze setter and turning clockwise until the setter stops or a click is heard. He should then remove the setter and make a visual check of the fuze setting.

c. Sets Other Fuzes.

- (1) When FUZE QUICK is announced, No. 3 will verify the superquick setting. (The

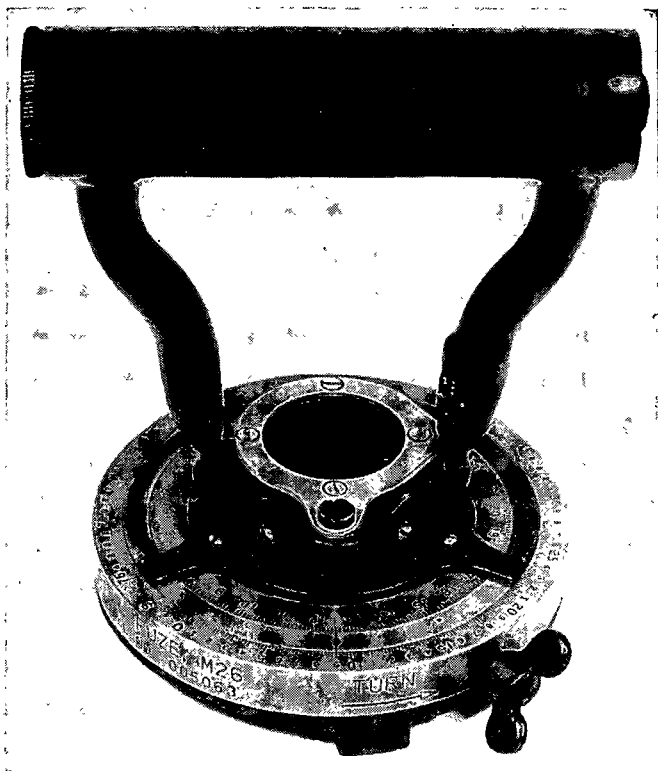


Figure 30. The fuze setter M26, set at 9.0.

slot on the setting sleeve should be alined with the letters SQ.) When FUZE DELAY is announced, he will turn the setting sleeve with a screwdriver until the slot is alined with the word DELAY.

- (2) Combination time and superquick fuzes will detonate on impact if the time element fails. For impact action the command is FUZE

M500 (or other fuze) QUICK. For a superquick action No. 3 verifies that the *S* on the time ring is alined with the index; if not, he alines them.

d. Uses Fuze Setter M27. This is a wrench-type fuze setter in which the fuze time scale is used in setting the fuze. No. 3 engages the setter in the notch on the setting ring of the fuze and rotates the ring in the direction of increasing readings until the announced time setting is opposite the index mark on the fuze. This type of setter should be used only when mechanical setters are not available.

Caution: A time fuze should not be set more than twice, and should be returned to ordnance if not fired after two settings.

e. Assists No. 1 in Shifting Right Trail. See paragraph 25*g* for detailed description.

28. Number 4

The duties of No. 4 cannoneer are as follows:

a. Prepares Charges. When the designation of the charge is given in the fire command, No. 4 verifies the number of increments and removes those higher numbered increments. He then replaces the remaining charges in the cartridge case in their original numerical order. After preparing the charge, he fits the projectile to the cartridge case assisted by No. 6.

b. Assists No. 3 in Setting Fuzes. See paragraphs 27*a* through *d* for details (fig. 31).

c. Passes the Round to No. 2. With his left hand under the cartridge case and his right hand under the projectile, No. 4 passes the round so No. 2 can grasp the base of the cartridge case in his right hand



Figure 31. Setting the fuze.

(fig. 28). No. 4 must insure that the projectile and cartridge case do not separate.

d. Replaces Increments in Cartridge Cases Prior to Replacing in Containers. Under the supervision of the chief of section and assisted by No. 5 and 6, No. 4 replaces charges in the cartridge case in proper numerical order prior to repacking. He must check that all seven charges of the proper lot number are present and that they are in serviceable condition.

29. Number 5

The duties of the No. 5 cannoneer are as follows:

a. Sets Out and Assists the Gunner in Alining the Aiming Posts. See paragraph 24c for details.

b. Removes Ammunition from Containers. No. 5 and 6 remove rounds from the containers and arrange them within easy reach of No. 4. All rounds are

inspected to see they are free of sand and dirt and that the rotating band is not burred. The rounds are wiped with a cloth and any burred rounds placed aside until the burrs are removed with a file.

c. Replaces Unused Ammunition in Containers. Under the supervision of the chief of section, No. 5 and 6 replace unused ammunition in the proper containers according to lot number.

30. Number 6

The duties of the No. 6 cannoneer are as follows:

a. Assists No. 5 in Preparing Ammunition. See paragraph 29*b* for details.

b. Assists No. 4 in Preparing Charges. See paragraph 28*a* for details.

c. Assists No. 2 in Shifting Left Trail. When directed by the gunner, shifts left trail as described in paragraph 26*c*.

d. Assists No. 5 in Replacing Unused Ammunition in Containers. See paragraph 29*c* for details.

Section II. DIRECT LAYING, GENERAL

31. General

a. Firing by direct laying is a special technique that demands a high standard of training. The section must operate as an independent unit. Training in direct laying is based on the technique employed in indirect laying. Enemy targets taken under fire by the section in direct laying are usually those capable of returning fire on the gun section at point-blank range; therefore, the speed and accuracy required in indirect laying becomes even more important for direct laying missions.

b. The two basic systems of direct laying for use



Figure 32. Two-man, two-sight system (direct laying).

with the 105-mm howitzer and the *two-man, two-sight system* (pars. 35–39) in which the gunner, using the panoramic telescope, lays for direction, and No. 1, using the elbow telescope, lays for range (fig. 32) and the *one-man, one-sight system* (pars. 40–43) in which the gunner lays for both direction and range using the panoramic telescope.

c. The chief of section will designate the system of laying to be used for firing direct fire. Selection of the system depends on which method can more effectively engage the target. Training must include both systems of direct laying.

32. Preparation of a Range Card

a. The chief of section is responsible for defense in his assigned sector. He should be prepared to deliver direct fire in all sectors.

b. As soon as possible after occupying a position, the section chief measures or estimates the ranges to prominent terrain features near likely avenues of approach for enemy tanks and vehicles, and prepares a range card (fig. 33) on which he notes the

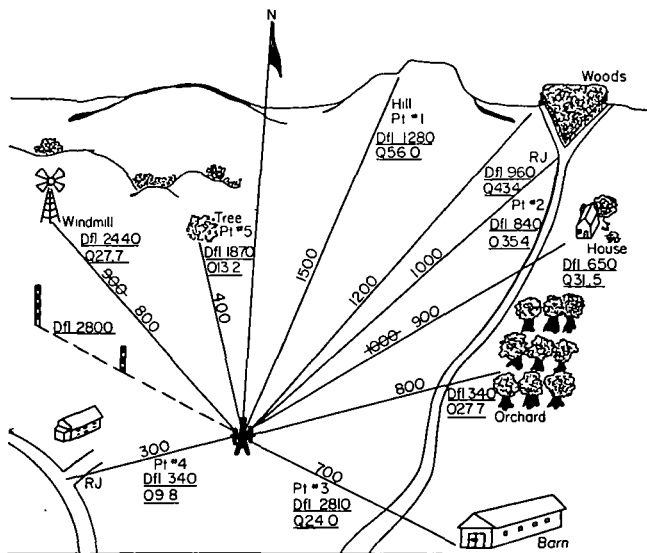


Figure 33. Range card for direct laying.

ranges for quick reference. This card should be prominently displayed at the piece at all times.

c. If there are no prominent terrain features, stakes may be driven into the ground at critical points for reference. As time permits, the range card should be improved by replacing estimated ranges with more accurate ranges obtained by firing, pacing, taping, vehicle speedometer reading, map measurement, or survey.

d. The battery executive assigns point numbers to certain prominent terrain features around the battery area. This facilitates sending the direct fire order to the firing battery by the executive or outposts; for example TARGET, TANKS POINT NO. 4 FIRE AT WILL.

e. As time permits, a deflection and quadrant for the point numbers should be added to the range card to increase accuracy in night firing, when the points are not clearly visible through the telescope (table III).

33. Field of Fire

a. The sections are given fields of fire which are integrated into the battery defense plan. These sectors of responsibility (fig. 34) must overlap slightly and provide all-round coverage.

b. The sector of fire for the howitzer should, if possible, be cleared of all obstructions that might endanger battery personnel when the piece is fired, or that might hinder observation. Care should be taken not to expose the location of the position.

34. Conduct of Fire

a. Trajectories. Trajectory characteristics change

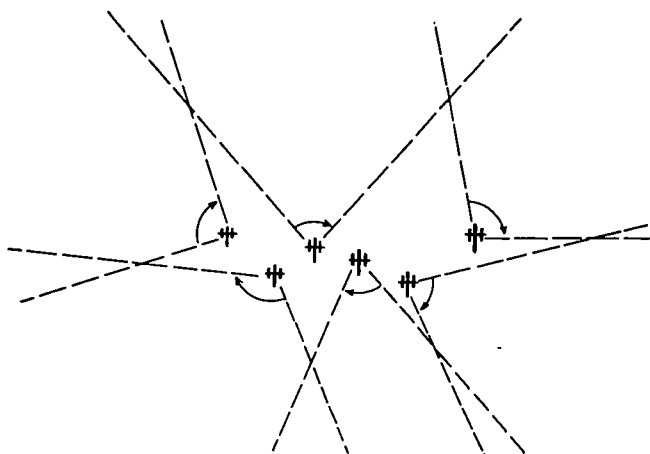


Figure 34. Sector of responsibility.

with the type of ammunition and the charge fired. The following trajectory characteristics govern the conduct of fire:

- (1) *Ranges from 0 to 400 meters using HEAT or ranges from 0 to 600 meters using HE charge 7.* Within these range limits, the trajectory will be flat enough to prevent an 8-foot tank from passing safely under it. Fields of fire and terrain allowing the upper range limits for the ammunition and charge used are the ideal at which to open fire. Fire can then be conducted over the maximum time without misses if deflection is correct. Also there is less risk of obscuring the target with the smoke from a short burst.
- (2) *Ranges from 400 to 700 meters using*

HEAT or 600 to 1,000 meters using *HE* charge 7. These range limits include the zone in which the trajectory is sufficiently flat to permit direct estimation of range without actually bracketing the target. Assuming little dispersion, if a hit is obtained at the bottom of an 8-foot tank firing at the upper range limit (700 meters for example, with *HEAT*) the adding of a 100-meter range change will result in a round which will just brush the top of the tank. During adjustment within this zone, range changes should seldom be more than 100 meters, and frequently range changes of 50 meters will be sufficient. The upper limits mentioned herein are the greatest ranges at which fire should be opened unless tactical conditions require otherwise. A trained crew should obtain a hit with the second shot.

- (3) *Ranges from 700 to 1,300 meters using HEAT or 1,000 to 1,800 meters using HE charge 7. This zone includes the ranges at which hits are only reasonably possible. Bracket methods are normally used to obtain adjustment in this zone. There is more dispersion in this zone and fire should not be opened at these ranges unless surprise is not important.*
- (4) *Ranges over 1300 meters using HEAT or over 1,800 meters using HE charge 7. At ranges over 1,300 meters using HEAT or over 1,800 meters using HE charge 7,*

direct laying against moving targets is not advisable. Dispersion is the controlling factor. Ranges must be known accurately or determined by bracketing. At these ranges the slope or fall of the projectile becomes so great that a hit on a moving target is very difficult to obtain.

b. Vertical Displacement Table. Vertical displacement is the change in the point of burst (up or down) between two rounds fired at an upright target at different range settings. Table III shows the vertical displacement for a 100-meter range change at various ranges, firing shell HEAT and shell HE charge 7.

c. Types and Selection of Targets for Direct Laying. Targets for direct laying usually consist of hostile vehicles, tanks, and personnel threatening the battery. Enemy personnel, whether alone or accompanying tanks, will seldom present themselves as a clearly defined target. Normally, attacking infantry, using all available cover, reveal themselves only fleetingly. Accordingly fire is conducted on the area containing the attackers rather than upon the individuals. Tanks usually attack in groups and may be accompanied by infantry. Normally, first priority is given to attack of those targets within the assigned sector of the weapon and second to targets in other sectors. Priority within the assigned zone is given to—

- (1) Tanks at short ranges, threatening to overrun the position.
- (2) Hull down stationary tanks, covering the advance of other tanks.

64 TABLE III. *Vertical Displacement (Feet) Per 100-Yard/100-Meter Range Change With Corresponding Elevations For Night Firing*

Shell HEAT				Remarks	Shell HE, Charge 7			
(Meters)	Range (yards)	Elevation (mil)	Displacement (feet)		Displacement (feet)	Elevation (mil)	Range (yards)	(Meters)
100	100	3.1	1	Start firing using 400 meter range setting.	0.5	2.0	100	100
200	200	6.4	2		1.5	4.1	200	200
300	300	9.8	3		2.0	6.3	300	300
					2.5	8.4	400	400
					3.5	10.6	500	500
400	400	13.2	4	Start firing with estimated range. Increase or decrease by multiples of 50 or 100 meters. Bracketing not necessary.	4.0	12.8	600	600
500	500	16.7	5.5		5.0	15.1	700	600
500	600	20.3	6		5.5	17.4	800	700
600	700	24.0	8		6	19.7	900	800
					7	22.1	1,000	900
700	800	27.7	9.0	Bracket target (get bursts over and short) to obtain hit.	8	24.5	1,100	1,000
800	900	31.5	10.5		9	27.0	1,200	1,100
900	1,000	35.4	11.5		10	29.5	1,300	1,200

1, 000	1, 100	39. 4	13. 0		10. 5	32. 0	1, 400	1, 300
1, 100	1, 200	43. 4	14. 5		11. 5	34. 6	1, 500	1, 400
1, 200	1, 300	47. 5	16. 0		13	37. 3	1, 600	1, 500
					14	40. 0	1, 700	1, 500
					14. 5	42. 7	1, 800	1, 600
over 1,200	over 1,300	-----	-----	Firing at moving targets at this distance is too inaccu- rate (par 34a(4)).	-----	-----	over 1, 800	over 1, 600

Note. Information computed with data obtained from FT 105-H-4.

d. Ammunition and Fuzes.

- (1) *General.* For close-in fires, a variety of fuzes and shells are available. When high explosive shell is used, charge 7 is used habitually for speed, ease in adjustment, more effective fuze action, and imparting forward motion to fragments. The flat trajectory resulting from the use of charge 7 coupled with dug-in weapons may make extremely close-in fire impossible due to projectiles skipping without detonating on impact. At ranges of 200 to 400 meters fuzes may fail to function on hard, flat ground; however, preparation of sectors of fire will remedy this situation. The terrain may be prepared for direct fire by placing mounds of sandbags, dirt, or logs in the section's sector of responsibility. When direct fire is placed on these or other previously selected points, as they are approached by an attacking force, the necessity for adjusting fire is reduced.
- (2) *Ammunition.* Ammunition may be HE, HEAT, or white phosphorus (WP). HEAT is designed for, and is highly effective in, antitank and antivehicle fires. HE is ideally suited for antipersonnel fire and is effective against vehicles and tanks. WP may be used to set immobile tanks and vehicles on fire, to further restrict defiles, and to produce casualties. However, consideration must be given to the effect on the defense of the resulting smokescreen.

(3) *Fuzes.* Base detonating fuzes are contained in HEAT projectiles. WP ammunition is fuzed with a superquick-delay fuze; HE may be used with fuzes quick, delay, or time.

(a) Fuze quick is the most desirable fuze to use with HE shell for close-in fires. It is highly effective and, since no fuze setting is required, is much faster to use.

(b) The time required to set the fuze and to adjust the point of impact for maximum ricochet effect makes fuze delay less desirable than fuze quick. When using fuze delay to gain ricochet effect, the point of impact is adjusted 10 to 30 meters in front of the target. If less than 50 percent of the bursts are ricochet, the fuze should be changed to quick.

(c) Fuze time is the least desirable type of fuze for close-in fires. Due to the wide range dispersion resulting from variation in time of burning with short fuze settings, this fuze should be used only for ranges of more than 1,000 meters. The areas covered effectively by air and ricochet bursts are similar.

Section III. DIRECT LAYING, TWO-MAN, TWO-SIGHT SYSTEM

35. Chief of Section

The duties of the chief of section are as follows:

a. *Conducts the Fire of His Piece.* When the executive commands TARGET, TANK POINT

NO. 6, FIRE AT WILL, or simply FIRE AT WILL, the section chief takes control of the mission.

b. Identifies or Selects the Target. When the executive designates an object or one of a group of objects as the target, the chief of section must correctly identify his target. If the target is a group of tanks or other objects, the chief of section selects the target that, in his estimate, is the greatest threat to his own position or the position of the supported troops.

c. Estimates the Range to the Target. A well-prepared range card (par. 32 and fig. 33) with ranges to key points recorded provides the best means for determining the initial range. Without the range card, the range must be estimated.

d. Determines the Lead in Mils. Lead is determined by the speed of the target, range, course at which it is moving, and charge being fired. With shell HEAT suggested initial leads are slow (0-5 mph), 5 mils; medium (5-10 mph), 10 mils; fast (10-15 mph), 15 mils (fig. 35). From the observed effect, the lead is changed as necessary.

e. Gives Initial Command. The chief of section will give fire commands containing the following elements in sequence:

(1) *Target designation.* The command is TARGET (TANK, etc.).

(2) *Projectile, charge, and fuzes.* The command specifies the appropriate items in sequence; e.g., SHELL HE, CHARGE 7; FUZE DELAY or SHELL HEAT. With shell HEAT, no command for charge or

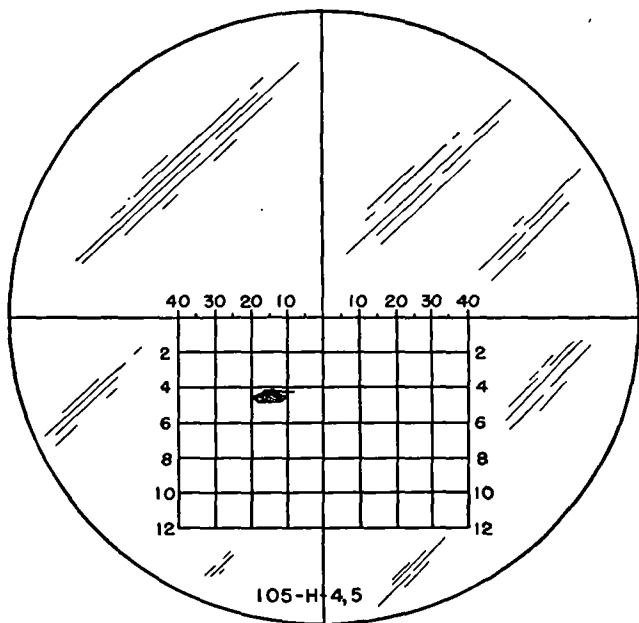


Figure 35. Gunners sight picture lead 15 mils.

fuze is necessary because these are not variable but are fixed.

- (3) *Lead.* The command is LEAD (so much). See *d* above for the estimating.
- (4) *Method of fire.* Fire is continuous unless otherwise commanded. The piece is loaded and laid as rapidly as possible and fired on the command of the gunner.
- (5) *Range.* The command is RANGE (so much). The range commanded by the chief of section is to be set on the sight

reticle of the elbow telescope (par. 37a). When firing charges other than those for which the reticle is graduated, the chief of section converts his estimated range to an appropriate range command for the charge and telescope being used. For example, in firing shell HE, charge 7, at a range of 800 meters using the elbow telescope graduated from shell HEAT, the command is RANGE 500. Table III shows that elevation 17.4 mils corresponds to a range of 800 meters firing shell HE, charge 7. The closest elevation to this in the HEAT column is 16.7 mils which corresponds to a range of 500 meters. A conversion table for other charges may be prepared using the firing tables.

f. Gives Subsequent Commands, Based on Observed Effect.

- (1) *Change in lead.* During adjustment, the lead is changed by the command LEFT (RIGHT) (so much).
- (2) *Change in range.* During adjustment, the range is changed by the command ADD (DROP) (so much). See paragraph 34 for determining range changes during adjustment of fire.

36. Gunner

The duties of the gunner are as follows:

a. Centers the cross-level bubble on panoramic telescope mount.

b. Lays on the target with the announced lead and tracks the target.

- (1) Prior to any direct fire mission, the gunner verifies that the movable azimuth micrometer (gunner's aid) index is set at zero.
- (2) Zeros the nonslipping azimuth, the slipping azimuth, and slipping micrometer scales.
- (3) The operations in (1) and (2) above make the line of sight of the panoramic telescope parallel with the axis of the bore. The gunner then tracks the target using the traversing handwheel to keep the appropriate vertical line of the telescope on the center of the visible mass of the target. The announced lead is measured on the horizontal reticle scale (fig. 35). In the two-man, two-sight system, the vertical location (range) of the target is controlled by No. 1.
- (4) If the chief of section does not announce a lead, it is estimated by the gunner.

c. Commands FIRE. After No. 1 has called "Set" and when he is ready, the gunner commands FIRE.

d. Follows subsequent fire commands (par. 35f).

37. Number 1 (Assistant Gunner)

The duties of the assistant gunner are as follows:

a. *Lays for Range.* Using the elbow telescope, No. 1 sets off the range commanded by the chief of section by placing the appropriate range line of the reticle on the center of the visible mass of the target.

b. *Tracks the Target.* With the elevation hand-

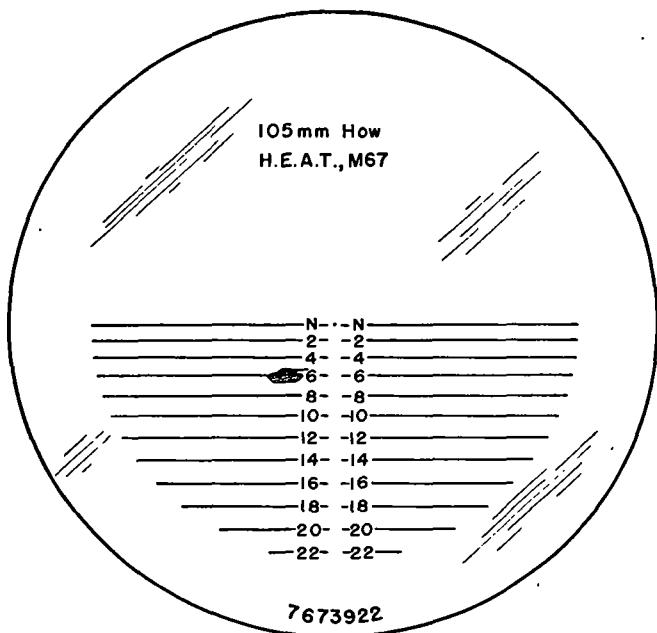


Figure 36. Number 1's sight picture elbow telescope.

wheel, No. 1 keeps the proper range line on the center of the target (fig. 36).

c. Calls "Set." When the piece is loaded and the correct range line is on the target, No. 1 calls "Set" and continues to call "Set" until the piece is fired.

d. Follow Subsequent Commands. See paragraph 35f.

38. Number 5

The No. 5 man opens and closes the breech, taps on No. 1's shoulder when the howitzer is loaded, and fires the piece at the gunner's command.

39. Remainder of Section

The remainder of the section perform the duties prescribed for indirect laying.

Section IV. DIRECT LAYING, ONE-MAN, ONE-SIGHT SYSTEM

40. Chief of Section

The duties of the chief of section are the same as in the two-man, two-sight system (par. 35).

41. Gunner

The duties of the gunner are as follows:

a. Matches the Elevation Indexes. The gunner matches the sight mount elevation indexes on the actuating arm and rocker and those on the elevation knob and shaft. He then sets the elevation indexes and azimuth scales of the panoramic telescope at zero. All slipping scales are zeroed.

b. Centers the Cross-Level Bubbles. After laying approximately on the target, he centers the telescope mount cross-level bubble.

c. Lays on the Target.

- (1) He lays on the target with the announced *lead* and *range* measured on the scales of the reticle (fig. 37).
- (2) The reticle of the panoramic telescope is graduated for shell HE, charge 5. At ranges under 2,400 meters the elevations for charge 7 are almost half those for charge 5. Therefore, the reticle can be used for charge 7 by laying with half the true range. When firing shell HEAT, the correct range setting

is determined by the chief of section (par. 35e(5)).

d. Other Duties. Other duties are performed as in the two-man, two-sight system (par. 36).

42. Number 1 (Assistant Gunner)

The duties of N^o. 1 when using the one-man, one-sight system are to open and close the breech, call "Set" when the howitzer is loaded, and fire the piece at the gunner's command.

43. Remainder of Section

The remaining cannoneers perform their duties as prescribed for indirect laying.

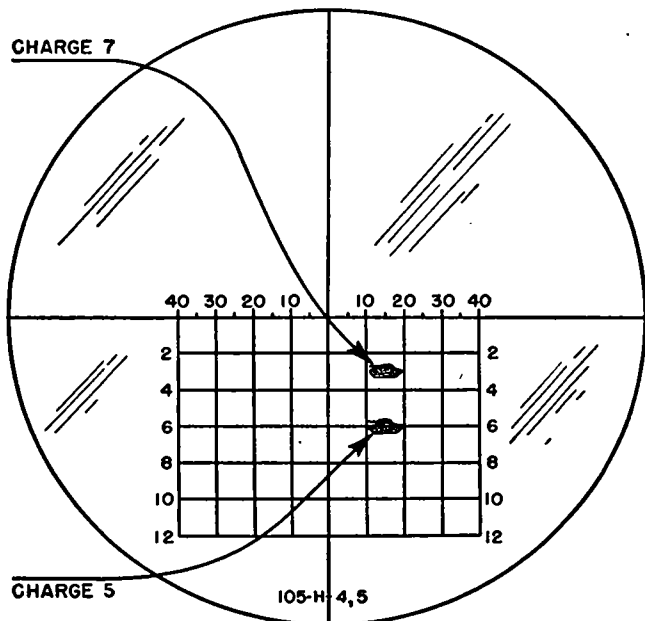


Figure 37. Gunner's sight, one-man, one-sight system.

CHAPTER 6

TECHNIQUES AND SITUATIONS THAT REQUIRE SPECIAL ATTENTION

44. Precision in Laying

a. Sighting and laying instruments, fuze setters, and elevating and traversing mechanisms must be properly operated to reduce the effects of lost motion. This requires that the last motion in setting the instruments and in laying the piece be in the direction prescribed in this manual. To insure accurate laying, personnel who have duties in connection with laying the weapon must be required to verify the laying after the breech has been closed.

b. The line of sight in setting and reading a scale or centering a bubble should be at a right angle to the scale or level vial to prevent parallax errors. Bubbles should be centered exactly.

c. For uniformity and accuracy in laying on aiming posts, the vertical reticle of the panoramic telescope should be alined with the left edge of the aiming posts.

45. Aiming Points and Displacement Corrections

a. General. After the piece has been laid initially for direction it is referred to the aiming posts and usually to one or more distant aiming points as described in paragraph 24*d*. An aiming point must have a sharply defined point or vertical line clearly visible from the howitzer so that the vertical reticle

of the panoramic telescope can be alined on exactly the same place each time the piece is relaid.

b. Distant Aiming Point. A distant aiming point is selected at sufficient distance so that normal displacements of the weapon in firing or traverse will not cause a horizontal angular change in direction (with the same settings on the azimuth scales) of more than one-half mil. The executive officer usually designates any distant aiming point or points to be used.

c. Aiming Posts.

- (1) Two aiming posts are used for each weapon. Each post is equipped with a light for use at night. The most desirable distance from the howitzer to the far aiming post, considering accuracy of laying, visibility, and ability to control the aiming post lights, is 100 meters. The near post is set up halfway between the far post and the howitzer and is lined in by the gunner so that the vertical reticle of the telescope and the two aiming posts are in alinement. To insure equal spacing of aiming posts, the distance to both the near and the far post should be paced by the same man. Where ground conditions make pacing inaccurate, the distance from the piece to the posts may be measured using the panoramic telescope, with the aiming post as a stadia rod ((4) below).
- (2) For night use, the aiming post lights should be adjusted so that the far light will appear several feet above the near one. Placed in

this way the two lights will establish a vertical line for laying the howitzer.

- (3) Since the panoramic telescope is mounted at considerable distance from the center of rotation of the top carriage, large changes in deflection will cause misalignment of the aiming posts. Placing the aiming posts to the left front at a deflection of approximately 2,800 (2,600) when the howitzer is in center of traverse will keep this misalignment to a minimum and still allow for maximum visibility (*d* below).
- (4) To measure the distance from howitzer to aiming posts the stadia method may be employed, using the panoramic telescope and the aiming post as measuring devices. Number 5 cannoneer, when setting out the aiming posts, holds the upper section of one of the aiming posts in a horizontal position, perpendicular to the line of sighting. The gunner measures the length of this section in mils on the reticle of the panoramic telescope. For example, the upper section of the aiming post is $4\frac{1}{2}$ feet long, and it measures 17 mils when it is 100 meters from the howitzer. The proper location for the near post, in this case, would be at the point at which the $4\frac{1}{2}$ -foot section measures 34 mils. In many cases, the ideal spacing of 50 and 100 meters cannot be obtained but the posts will be properly spaced when the near post is set at a point at which the $4\frac{1}{2}$ -foot section measures twice the number of

mils it measured at the far post location. This measurement may be performed at night by attaching the night lighting devices at the 4½-foot marks on the aiming posts.

d. Correction for Displacement of Aiming Posts.

When the gunner notes that the vertical reticle of the telescope is displaced from the line formed by the two aiming posts (or aiming post lights), he lays the howitzer in such a manner that the far aiming post (light) appears exactly midway between the near aiming post (light) and the vertical of the reticle. If the displacement is due to traversing the piece, the gunner continues to lay as described above. If the displacement is due to progressive shifting of the carriage from shock of firing or other cause, the gunner will notify the chief of section, who, at the first lull in firing, will notify the executive and request permission to realine the aiming posts. To realine, the howitzer is laid with the far post midway between the near post and the vertical reticle. The far aiming post is moved into alinement with the vertical reticle of the telescope and then the near aiming post is alined. If terrain conditions make it impracticable to move one of the two aiming posts, the howitzer is laid for direction and referred to the aiming post which cannot be moved. This deflection is reported to the executive. The other post is alined using the method described in paragraph 24 and the azimuth micrometer scale is slipped to retain the same deflection that was used prior to realinement of the aiming posts. The explanation of aiming post displacement correction is shown in figure 39.

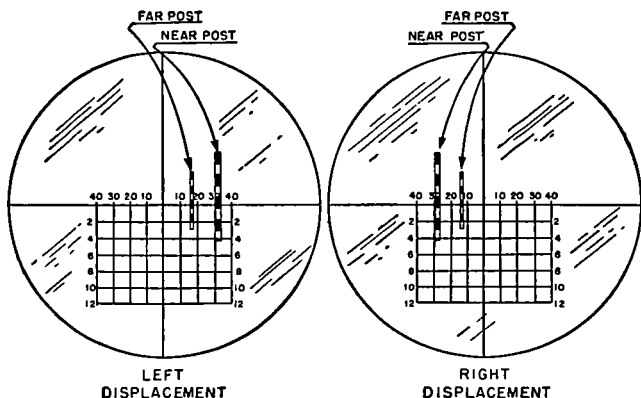


Figure 38. Gunner's sight picture for correcting aiming post displacement.

46. Preparation of Position for Emplacement of Howitzer

a. General. For detailed information on the preparation of the howitzer position see FM 5-15 and FM 6-140. The howitzer should be emplaced on level ground to insure stability in firing and to reduce the time needed for leveling the telescopes and range quadrant.

b. Spade Pits. Unless lack of time prevents, pits should be dug for the spades. On soft ground the spades can be seated by firing, but the displacement of the carriage will be greater than if the spades had been dug in initially.

c. Recoil Pits. A recoil pit with a full 50-inch clearance between the breech and the ground must be dug for high-angle fire. After the piece has been emplaced and, if possible, seated, it will be elevated to maximum elevation, and a recoil pit dug to insure

PROPOSITION:

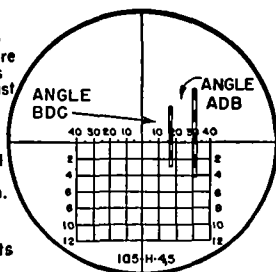
The new line of sight, $\overline{DC}$, is parallel to the line of aiming pasts, $\overline{PB}$, when the sight picture is such that the far aiming past (B) appears exactly midway between the near aiming past (A) and the vertical hair ($\overline{DC}$).

GIVEN:

1. The aiming pasts are initially positioned and aligned correctly. (The near past at the mid-point between the far past and the gun. The vertical hair of the telescope and the two aiming pasts in alignment.)

2. The gun (and sight) is displaced from its initial position. This displacement, $\overline{DP}$, is assumed as small compared to the distance from the gun to the near aiming past (PA). Therefore, the distance $\overline{PA}$ is assumed to be equal to the distance $\overline{DA}$.

3. The sight is partitioned so that $\angle BDC = \angle ADB$



TO PROVE:

That line $\overline{CD}$ is parallel to line $\overline{PB}$.

PROOF:

$$\overline{PA} = \overline{AB}$$

By initial placement of aiming pasts.

$$\overline{PA} = \overline{DA}$$

By initial assumption.

$$\therefore \overline{DA} = \overline{AB}$$

Things equal to the same thing are equal to each other.

$\triangle ADB$ is an isosceles triangle.

An isosceles triangle is a triangle two of whose sides are equal.

$\angle ADB = \angle ABD$ The base angles of an isosceles triangle are equal.

$\angle ADB = \angle BDC$ By measurement in the sight.

$\therefore \angle ABD = \angle BDC$ Things equal to the same thing are equal to each other.

$$\therefore \overline{PB} \parallel \overline{DC}$$

If two straight lines are cut by a third straight line, and the alternate-interior angles so formed are equal, then the two straight lines are parallel.

Q.E.D.

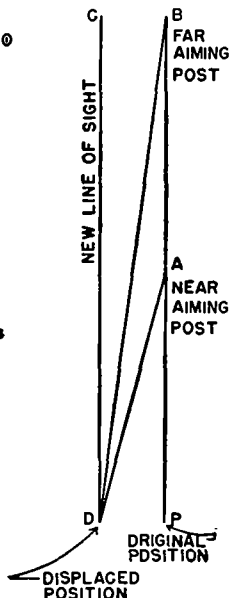


Figure 39. Mathematical explanation of aiming post displacement correction.

proper clearance throughout the limits of traverse. When the weapon is not firing high angle, the recoil pit should have an improvised cover to facilitate service of the piece.

47. Cease Firing

The command **CEASE FIRING** normally is given to the howitzer section by the chief of section, but in emergencies anyone present may give the command. At this command, regardless of its source, firing will cease immediately. If the howitzer is loaded, the chief of section will report that fact to the executive. The executive acknowledges this report by repeating it, "Number (so-and-so) loaded." If the command **CEASE FIRING** comes from the fire direction center, firing is resumed at the announcement of the quadrant; if from within the firing battery the executive will investigate the condition which caused the command to be given. When the condition has been corrected, firing is resumed by the executive's announcement of the quadrant.

48. Changes in Data During Firing

If it is necessary to correct any element of firing data, all firing previously ordered, but not yet executed, is stopped by the command **CORRECTION**. Corrected data is then announced. If the piece is not already loaded, the new data will be set off and firing resumed at the announcement of the quadrant. If the piece is loaded at the announcement of a new element of firing data, the new data will be set off. If no change in fuze setting is required, or if the piece is loaded with percussion-fuzed shell, firing is

resumed at the announcement of quadrant. If loaded with time-fuzed shell and the data requires a change in fuze setting, the chief of section will suspend firing and that fact will be reported to the executive; for example: "Number 2 loaded, time (so much)." In continuous fire, changes in data are so applied as not to stop the fire or break its continuity.

49. To Unload the Howitzer

a. A complete round, once loaded, should be fired in preference to being unloaded, unless military necessity dictates otherwise.

b. When the command UNLOAD is given, No. 1 opens the breech slowly; No. 2 standing at the breech, receives the ejected round or cartridge case.

c. Should the extractor fail to extract the complete round, the staff and unloading rammer (head) is used. This will be done under the immediate supervision of the chief of section. He inspects the recess in the head of the rammer to assure that it is free of obstructions. No. 1 then inserts the rammer in the bore until the head incloses the fuze and comes into contact with the projectile. He pushes and, if necessary, taps the rammer staff lightly, until the round is dislodged. He then pushes it out of the breech and No. 2 receives it.

d. If the cartridge case is extracted but not the projectile, No. 1 fills the chamber with waste and closes the breechblock. He dislodges the projectile as in *c* above. No. 2 then opens the breech, removes the waste, and receives the projectile as No. 1 pushes it to the rear.

e. For further information pertaining to unloading see TM 9-325 and TM 9-3007.

f. In case of a misfire, the instructions contained in paragraph 83 will be followed.

50. Care of Ammunition

a. To insure uniform results in firing, to prolong the life of the tube, and to avoid accident, great care must be exercised in the storage and handling of ammunition at the battery. The provisions of TM 9-1900 applicable to field service should be followed carefully. In the field, conditions existing in each position will determine the time, labor, and materials required to store and preserve the ammunition adequately. If the position is to be occupied for only a few hours, a tarpaulin spread on the ground may be sufficient; for longer periods of time, more elaborate facilities should be provided.

b. Ammunition must be protected from damage. When ammunition is received, it should be sorted into lots and placed in the best available storage. Powder temperature should be kept as uniform as possible. Ammunition data cards should be kept until all ammunition for that lot is expended. Ammunition should be left in containers until its early use is expected. Protection should be provided against moisture, dirt, direct rays of sun, and, as far as practicable, hostile artillery fire and bombing. Protection against weather, dirt, and sun may be obtained by the use of tarpaulins below and above the ammunition and suitable dunnage between the layers. Protection against hostile fire may be obtained by the use of small dispersed stacks, trenches,

or dugouts. Each stack should contain not more than 75 rounds and should be not more than 4 layers high. Stacks should be at least 10 meters apart.

c. For further information on care of ammunition see FM 6-40, TM 9-325, TM 9-1900, and TM 9-1901.

CHAPTER 7

BORESIGHTING AND BASIC PERIODIC TESTS

Section I. GENERAL

51. Purpose and Scope

The purpose of this chapter is to outline the procedures for boresighting and making basic periodic tests of on-carriage fire control equipment. The procedures covered will include only those that may be accomplished at battery level.

52. Equipment

The following equipment is needed for boresighting and periodic tests:

a. Boresights. Front and rear boresights or improvised substitutes are necessary for both boresighting and testing. If boresights are not available, crosshairs may be fastened on the muzzle, and the firing pin hole in the breechblock bushing may be used as a rear sighting guide by removing the firing lock from the closed breechblock.

b. Testing Target. A testing target or suitable substitute is needed for both boresighting and testing. Testing targets will be more useful if the following improvements are made.

- (1) The target should be mounted on a flat piece of masonite, wallboard, or similar material.

- (2) To insure stability of the testing target throughout boresighting, it should be fastened to a stand in a manner similar to that shown in figure 40.
- (3) For use in either leveling or canting the test target (par. 54b) a mil scale may be inscribed at the bottom of the target. A

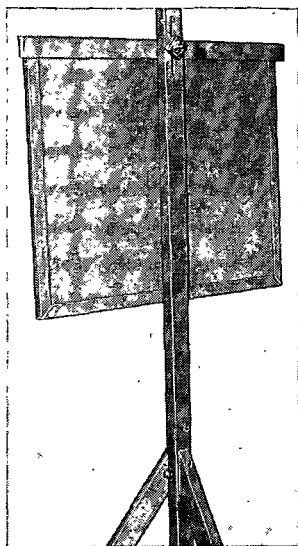


Figure 40. Rear view of boresighting target stand.

small nail at the top marks the center from which the arc was drawn and provides a hook from which to suspend the plumbline (fig. 41).

- (4) Vertical reference lines may be drawn through the centers of each of the diagrams

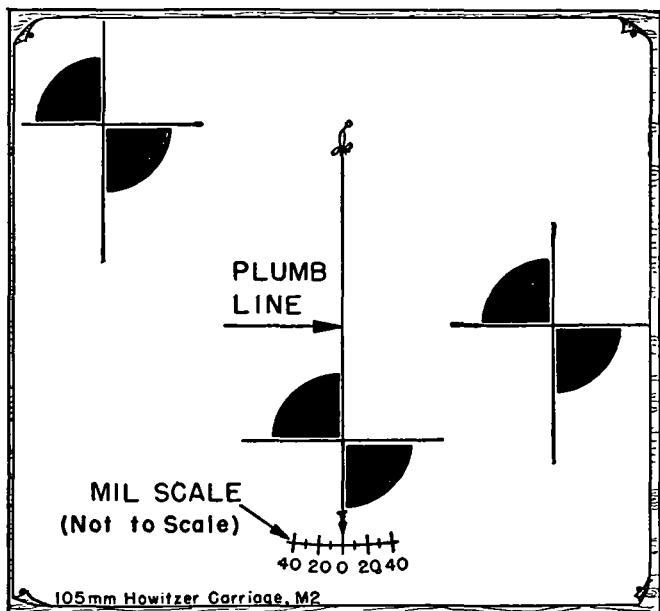


Figure 41. Mil scale inscribed on testing target.

(fig. 42). These lines may be used when the trunnions cannot be leveled by setting the test target with the cant angle of the gun. The target is rotated until the line of sight through the tube tracks the reference line when the tube is elevated and depressed. Similarly, the panoramic telescope should be adjusted so that its reticle tracks the appropriate reference line when the tube is elevated and depressed.

- (5) To facilitate boresighting in darkness a $\frac{1}{16}$ -inch hole should be bored through the

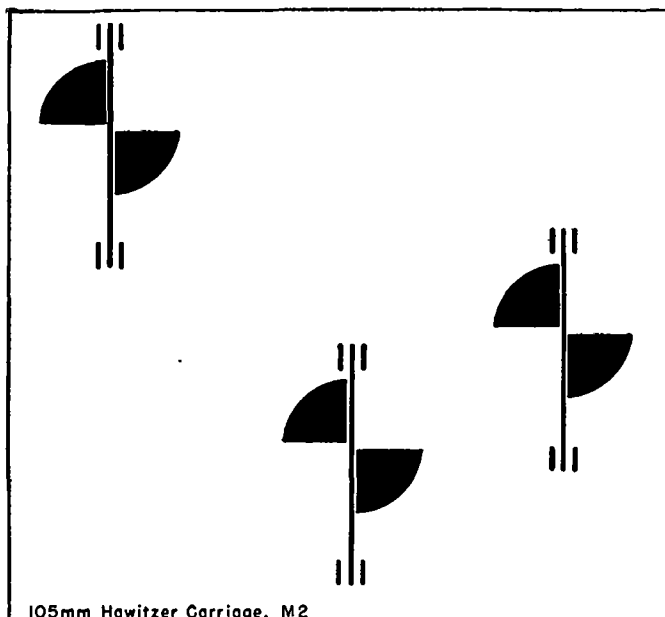


Figure 42. Vertical reference lines drawn on testing target.

mounted testing target at the center of each aiming diagram. A flashlight held against the target behind the appropriate hole provides an aiming point for use in blackout conditions. Patches of felt padding should be fastened on the back of the target covering the regions of each hold so that light from the flashlight will not escape. The flashlight must be lighted only after it is placed firmly in position. Care must be taken to prevent disturbing the position of the testing target.

- (6) If a testing target is not available, a clearly defined aiming point 2,000 or more meters from the gun may be used for the same purpose as the testing target.

c. Tools. The section equipment includes all the necessary tools for boresighting and testing. Care must be taken in using screwdrivers and wrenches to insure that damage does not result from carelessness or the use of inappropriate tools.

d. Plumbline. Although a plumbline is not essential for boresighting, it is highly desirable that one be used in the basic periodic test for maximum accuracy. The farther from the howitzer that the plumbline is placed, the longer the line must be. For example, to be effective at 6 feet in front of the gun tube, the line must be at least 30 feet long. To keep such a long plumbline taut it may be necessary to add weight to it. Wrenches or rocks may be used. The tendency of the weight to swing may be decreased by placing a bucket containing water or other liquid under the plumbline so that the plumb bob or other weight is partially immersed in the liquid. If a convenient means of suspension is not readily available, a pole may be employed as in figure 43. Additional height may be gained by placing the pole atop a vehicle or other object. A plumbline suspended from a building or tree as in figure 44 is more desirable and should be used if possible. Units in garrison may find it convenient to rig a plumbline on a building. The line may then be nailed in place so that it can be used permanently.

2"X4" ON EDGE DRILLED TO FIT OVER SPIKE
AND SHAPED TO LIGHTEN FREE END.

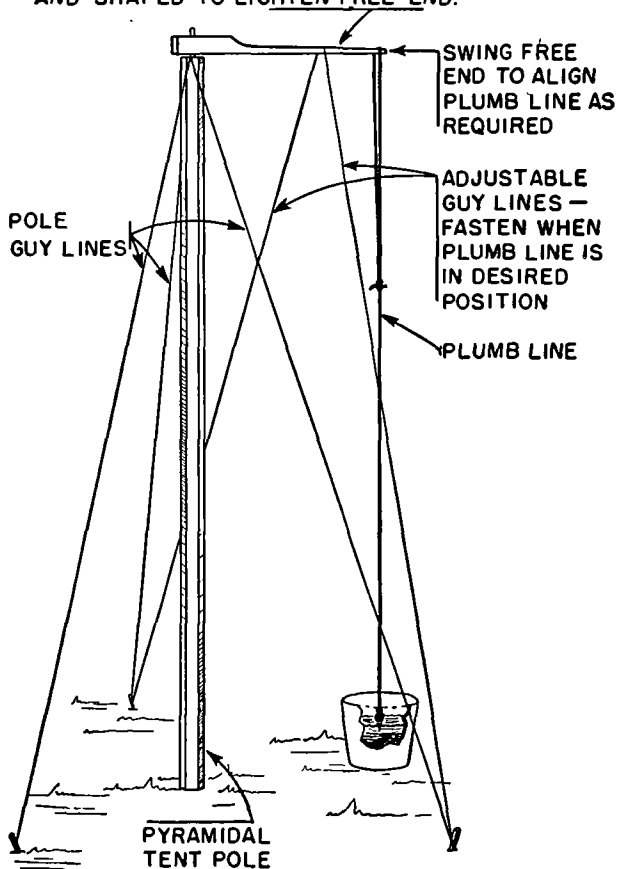


Figure 43. Improvised plumbline.

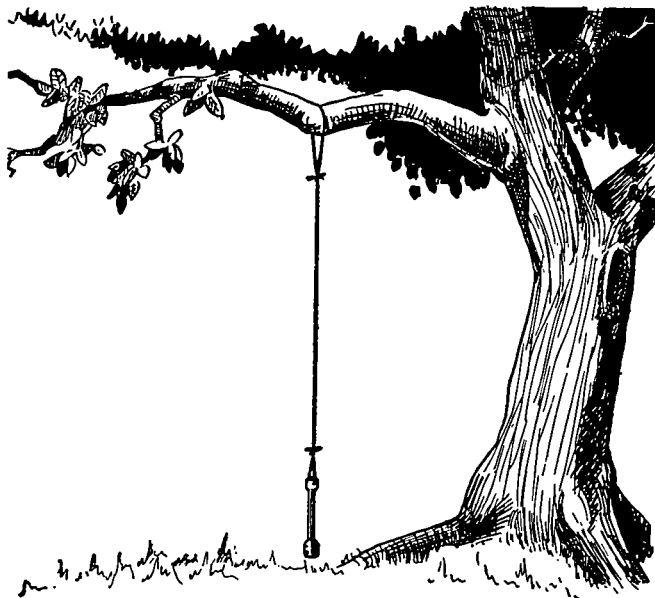


Figure 44. Plumbline suspended from a tree.

Section II. BORESIGHTING

53. General

a. Description. Boresighting is the process of alining the on-carriage fire control equipment so that its optical axes are parallel to the axis of the bore. It consists of those tests and adjustments which are performed by section personnel to insure accuracy in laying for elevation and direction. The piece should be placed near its center of traverse prior to boresighting. All instruments and mounts must be positioned securely; there must be no free play. Bore-

sighting is conducted before firing and when necessary during lulls in firing.

b. Leveling. Although it is not absolutely necessary to level the trunnions for boresighting, it is advisable to do so whenever possible. Accurate results can be obtained more readily if the trunnions are level, because then a corresponding tilt does not have to be introduced in the mounts and testing target. The trunnions should be leveled by leveling the ground under the trails or by blocking up one trail. Approximate leveling may be accomplished by use of the gunner's quadrant placed on the breech ring parallel to the trunnions.

- (1) *Plumbline.* The best method to check leveling is by means of the plumbline. The line is suspended directly in front of the axis of the bore. The line of sight should track the plumbline as the tube is depressed and elevated between maximum depression and at least 1,000 mils of elevation. When the trunnions are level, the line of sight tracks the plumbline exactly through all elevations. If the trunnions are not exactly level and the cant is only slight, to bring the trunnions into level, traverse the tube from center and shift the trails to bring the line of sight back on the plumbline. Elevate the tube to determine whether it more nearly tracks the plumbline. Repeat this experiment until the line of sight tracks the plumbline exactly.
- (2) *Gunner's quadrant.* In leveling operations using the gunner's quadrant, a quadrant that

has been tested (par. 58) and found to be accurate is required.

- (3) *Piece not level.* When it is impossible to level the trunnions the cross-level bubbles cannot be used. If the tube cannot be leveled, the longitudinal-level bubbles cannot be used. To permit boresighting when either of these conditions exist, lines should be scribed on the mounts after a basic periodic test (pars. 57-61) when the mounts are in correct adjustment. These scribed lines can be matched later, when leveling is impossible, to retain the same relationship between the axis of the bore and moving parts of the on-carriage sighting equipment. After a basic periodic test with the tube and sighting equipment in perfect alignment, use a knife blade or other sharp metal point to scribe the following lines:

- (a) Straight across the junction of the cross-leveling segment and the cross leveling worm housing of the panoramic telescope mount (3, fig 45) ;
- (b) Straight across the junction of the cross-leveling worm knob shaft and the cross-leveling worm housing (2, fig 45) ;
- (c) Straight across the junction of the rocker and the actuating arm (1, fig. 45 and 2, 46) ;
- (d) Straight across the junction of the longitudinal-leveling (elevation) knob shaft and the bracket (1, fig. 46).

On models having indexes on the elevation

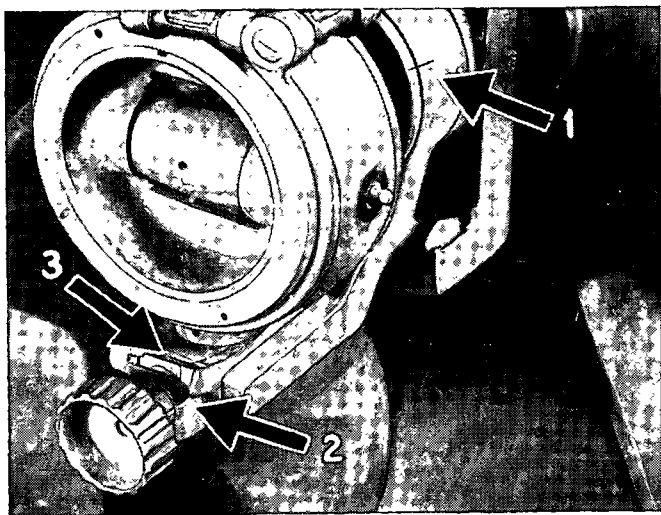


Figure 45. Scribe lines for positioning mount both laterally and longitudinally.

knob shaft and on the bracket, the elevating knob locking nut is loosened and the indexes slipped into coincidence (fig. 47). Care should be taken that the lines are scribed in the paint only and are not cut into the metal. Fill the scribed lines with white paint and wipe off the excess. If conditions prevent boresighting with the tube level, longitudinal compensation for an unlevel (elevated or depressed) tube is measured with the gunner's quadrant and this angle is set on the elevation micrometer instead of zero when adjustment is being checked (par. 54*i*).

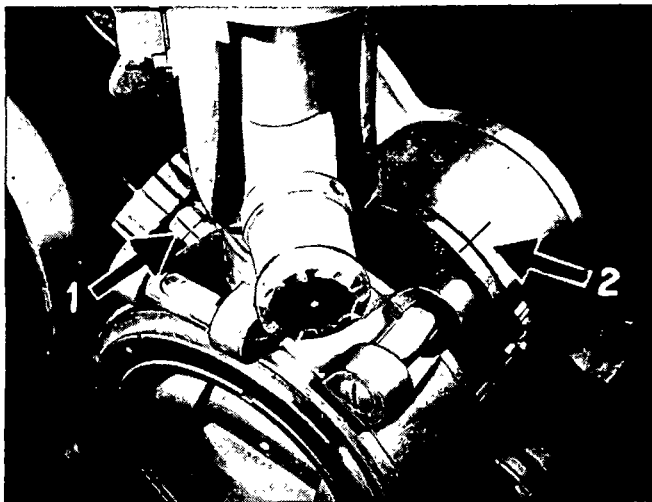


Figure 46. Scribe lines for positioning mount longitudinally.

c. Methods. The four methods of boresighting are—

- (1) Testing target.
- (2) Distant aiming point.
- (3) Aiming circle.
- (4) Standard angle.

54. Testing Target Method

This method consists of bringing the line of sight and indexes of on-carriage fire control equipment into parallel alinement with the tube, using the aiming diagrams of the testing target as aiming points.

Caution: For weapons modified per MWO ORD C21-W19, 2 November 1951 (i.e., a bracket added to raise the sight 8 inches), test target 1-T-283-42 is

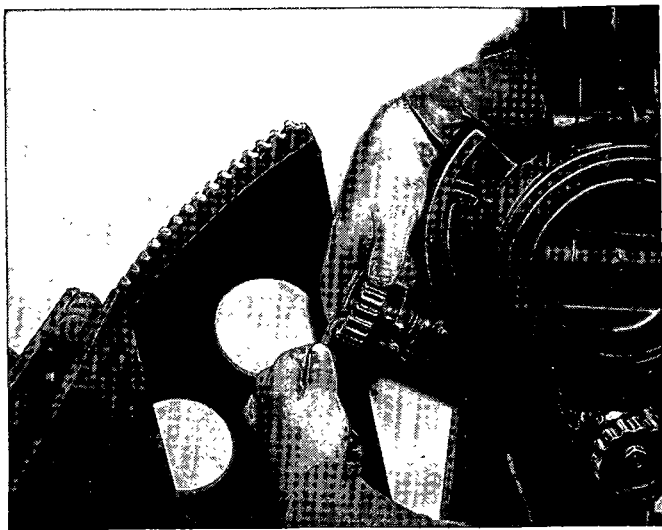


Figure 47. Slipping the longitudinal knob index into coincidence with the bracket index.

not correct and must have an additional diagram improvised above the sight diagram.

The steps to be followed are listed in *a* through *m* below:

a. Trunnions. Level the trunnions if possible (par. 53b).

b. Tube. Using the gunner's quadrant, level the tube.

c. Boresights. Place the breech and muzzle boresights in their proper positions (fig. 48).

d. Testing Target Alinement. Without moving the howitzer (except for elevating and depressing slightly when using testing target reference lines), aline the center testing diagram with the line of

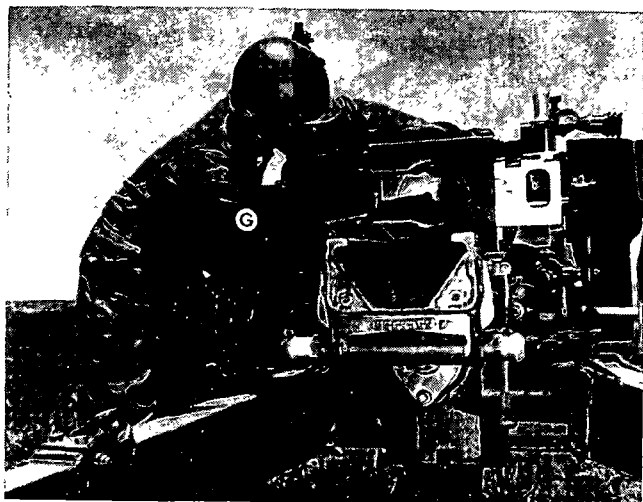


Figure 48. Emplacing breech boresight.

sight through the tube (fig. 49). The target normally should be located at least 50 meters in front of the muzzle.

e. Cant Compensation. If the trunnions are level, level the target by means of a plumbline (fig. 44). If the trunnions are not level, cant the target to correspond to the cant of the trunnions. In either case the face of the target is alined so that it is at right angles to the line of sight through the bore.

f. Panoramic Telescope Lateral Alinement. If the trunnions are level, level the cross-level and longitudinal-level bubbles. If the trunnions are not level, match the white scribed lines. Zero the sight as described in paragraph 24b. If the vertical reticle is not in alinement with its aiming diagram,

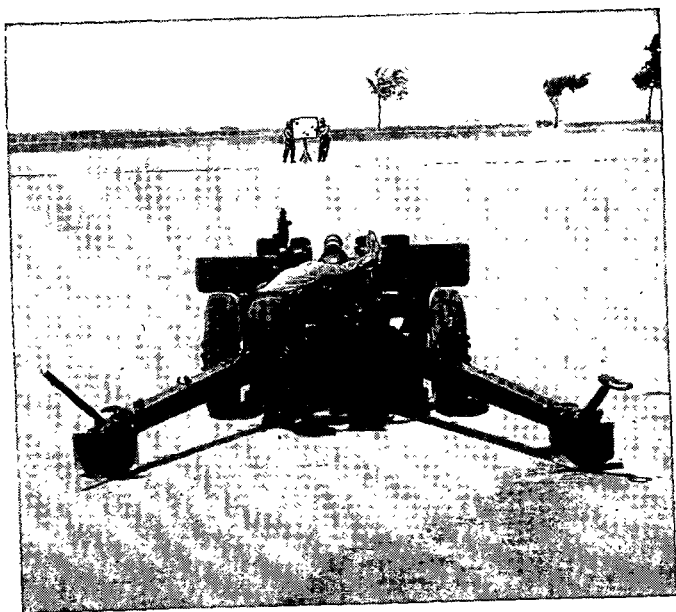


Figure 49. Alining the test target.

loosen the tangent locking screws (fig. 50) and adjust the tangent screws (fig. 51) until the vertical hair is properly alined. Tighten the locking screws and verify the adjustment.

g. Panoramic Telescope Horizontal Alinement. If the horizontal reticle is out of alinement, turn the elevation knob of the telescope (fig. 52) until it is alined properly. Loosen the clamping screws (fig. 53) and shift the scale into coincidence with the fixed index (fig. 54). Tighten the locking screws and verify the adjustment.

h. Elevation Index. Loosen the elevation index locking screws. Slip the movable index until it co-

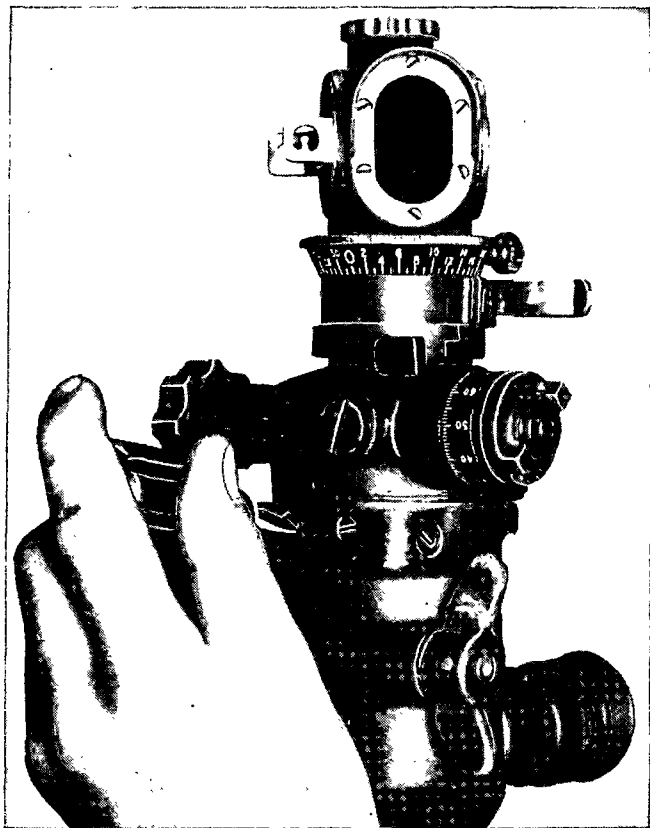


Figure 50. Loosening a tangent locking screw.

incides with the fixed index (fig. 55). Tighten the screws and verify the adjustment.

i. Range Quadrant. The elevation mechanism should be tested next. Verify that the locking screws of the elevation micrometer scale are tight. With the line of sight through the tube still on the

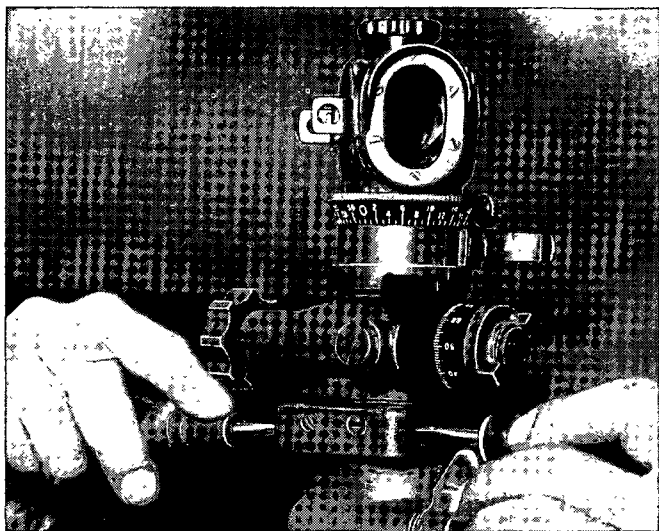


Figure 51. Adjusting the vertical reticle with tangent screws.

appropriate aiming diagram and with the elevation scale near or on zero, set the elevation micrometer scale at zero. Level the cross- and longitudinal-level bubbles of the range quadrant with the angle of site micrometer and the cross-leveling worm knob.

j. Elevation Scale Index. If the elevation scale index does not coincide exactly with zero, loosen the screws holding the index plate and slide the plate to zero (fig. 56). Tighten the screws and verify the adjustment.

k. Angle of Site Scale. If the angle of site scale does not read 3 (300) loosen the two locking screws of the scale and slip the scale until the numeral 3 is

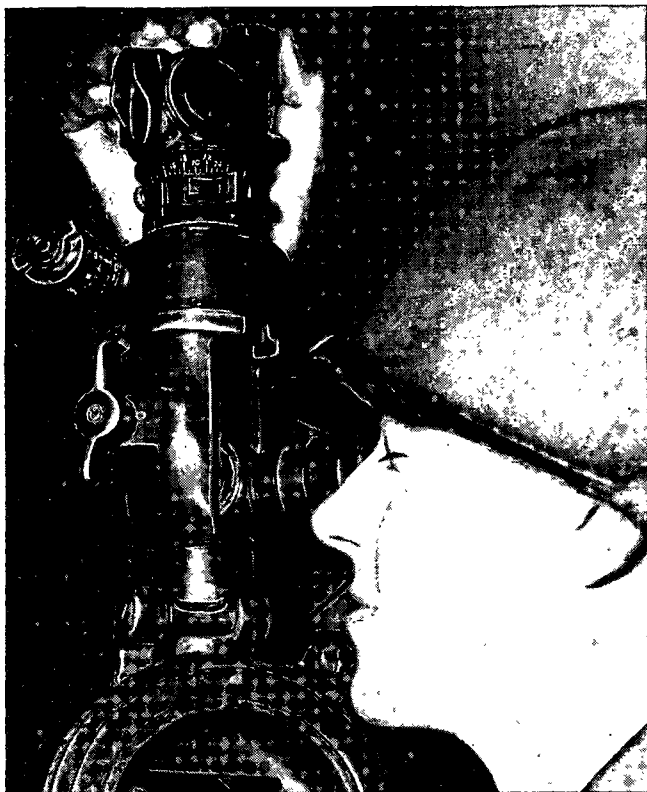


Figure 52. Alining horizontal reticle by turning elevation knob.

in coincidence with the index (fig. 57). Tighten the screws and verify the adjustment.

1. *Angle of Site Micrometer.* If the angle of site micrometer does not read zero, loosen the clamping screw in the micrometer knob and slip the scale to zero (fig. 58). Be sure that the knob does not turn

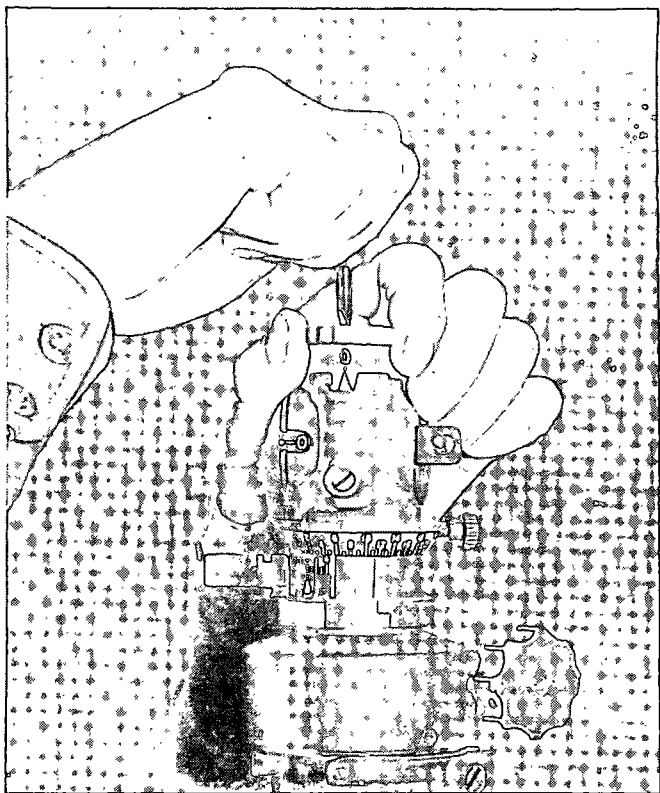


Figure 53. Loosening clamping screws.

and thus throw the longitudinal-level bubble off center. Tighten the locking screw and verify the adjustment.

m. Elbow Telescope.

- (1) *M23 mount.* No deflection adjustment can be made. If the zero range line of the elbow telescope does not match the horizontal

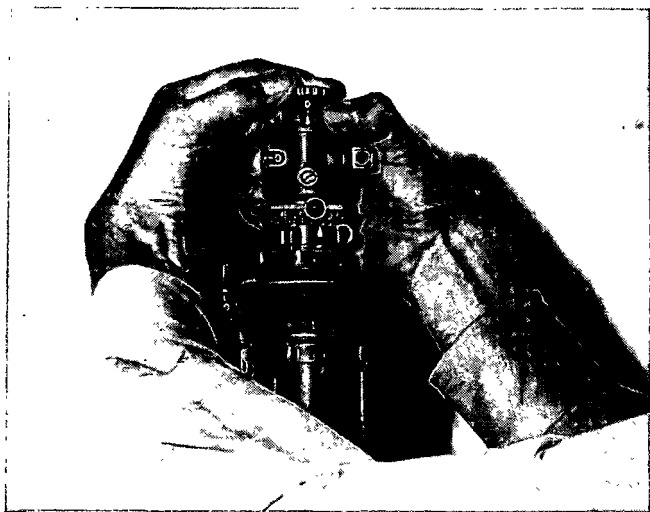


Figure 54. Shifting zero of the elevation knob to its index.

line of its aiming diagram, loosen the worm clamping bolt (fig. 59). With a screwdriver, bring the zero line into alinement with the horizontal line of the aiming diagram. Tighten the worm clamping bolt and verify the adjustment. If the horizontal reticle is not parallel to the horizontal line of its diagram, bring it into alinement by turning the bracket rotating knob.

- (2) *M42 mount.* There is no provision for leveling the reticle lines. If the vertical reticle is not in alinement, loosen the jam-nut on the lateral adjusting screw and, with a screwdriver, turn the lateral adjusting

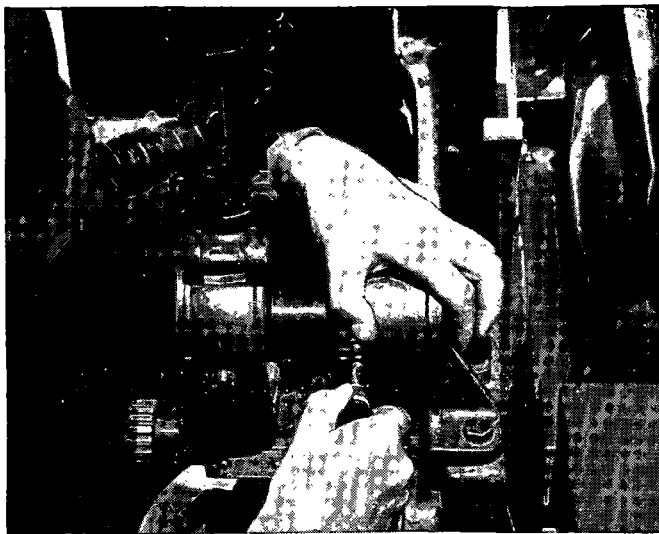


Figure 55. Shifting elevation index into coincidence.

screw to aline the reticle. Tighten the jamnut and verify the adjustment. If the horizontal reticle is not in alinement, loosen the jamnut on the elevation adjusting screw and, with a screwdriver, turn the elevation adjusting screw to aline the reticle. Tighten the jamnut and verify the adjustment.

55. Distant Aiming Point Method

This method consists of alining the on-carriage fire control equipment and the line of sight through the tube on a common point at least 2,000 meters from the howitzer. A distant aiming point may be



Figure 56. Shifting elevation scale index to zero.

used instead of the testing target if the testing target is not available or if the tactical situation makes its use impracticable. The steps prescribed for the testing target method (par. 54) apply except that the boresights and optical sights are alined on the same point instead of on the three diagrams of the testing target. Accurate cross-leveling of the trunnions is unnecessary when boresighting on a distant aiming point, because the lines of sight converge on a single point. It is improbable that that tube will

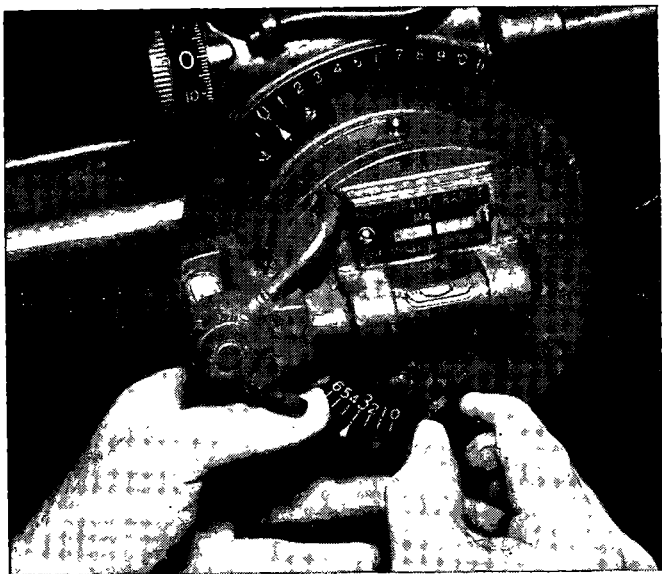


Figure 57. Shifting site scale to 3 (300).

be level, so normally the white scribed lines will be used.

56. Standard Angle Method

a. General. When positions are occupied in combat, the necessity for speed in opening fire or the necessity for observing camouflage discipline may make the boresighting methods previously described impracticable. Under such circumstances the alinement of the optical axis of the panoramic telescope parallel to the axis of the bore may be tested and adjusted by referring to a selected point on the muzzle. The deflection and elevation angles necessary to refer the line of sight of the telescope to the

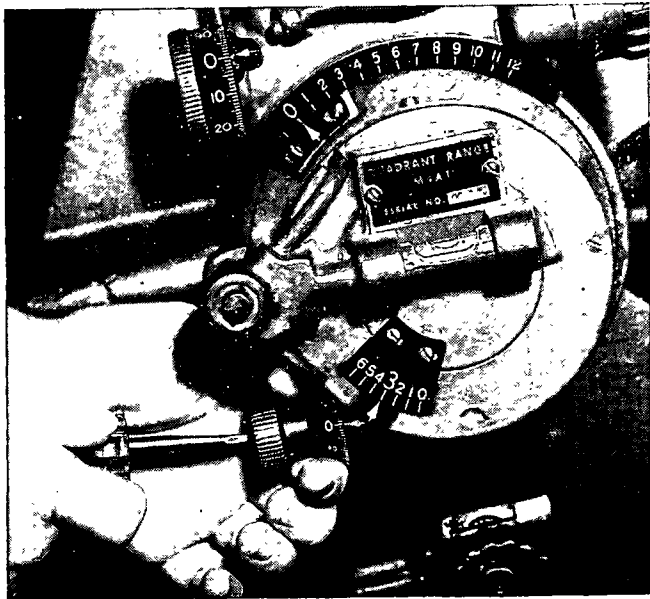


Figure 58. Adjusting angle of site micrometer scale to zero.

selected point of the muzzle will be referred to as the standard angles. During the basic periodic test, when the panoramic telescope has been found to be in correct alinement, is an ideal time to establish standard angles for later use. Once a standard angle has been determined, it may be used to test the alinement of the panoramic telescope when more precise methods cannot be used. Misalinement discovered and corrected as a result of this test should be verified by a more accurate method at the earliest opportunity. When using the standard angle method or boresighting be sure that the position of



Figure 59. Loosening worm clamping bolt of elbow telescope.

the recoiling parts with respect to the nonrecoiling parts is the same as they were when the standard angles were determined. The recoil system must be checked to see that it contains the proper amount of recoil oil before the standard angle is determined.

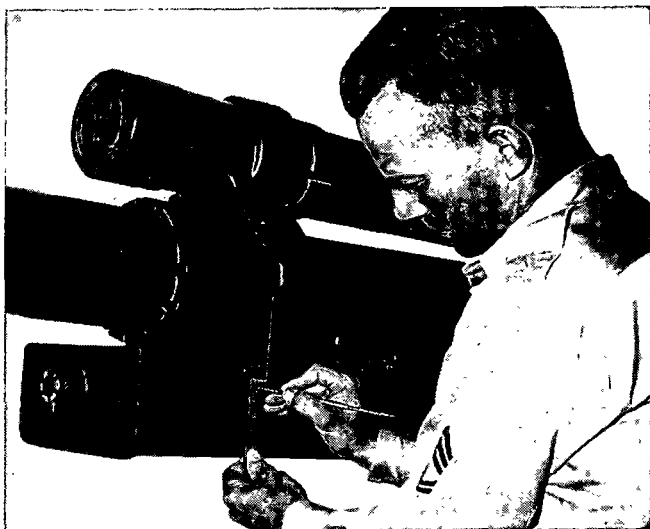


Figure 60. Scribing line to mark normal position of recoiling parts.

b. Preliminary Operations. The procedure for determining standard angles is as follows:

- (1) With the tube in battery, scribe lines in the paint to mark the position of parts which move in recoil with respect to parts which do not move in recoil (fig. 60).
- (2) Carefully level the trunnions.
- (3) Boresight the piece using a testing target.
- (4) With adhesive tape, fasten a bright common pin in the left horizontal witness mark. Allow the pin to project to the left of the muzzle (fig. 61).
- (5) Fasten the telescope parallax shield in place over the eyepiece.

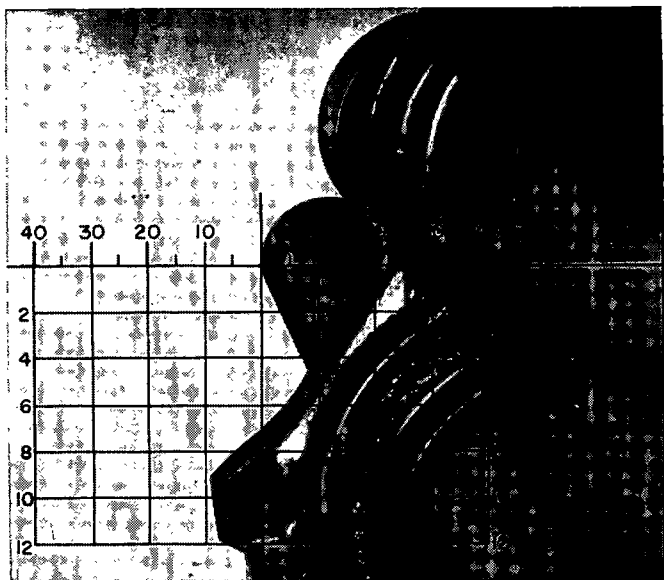


Figure 61. Sight picture of projecting pin.

- (6) Verify that the elevation index and micrometer on the telescope are at zero.
- (7) Elevate the tube until it is approximately level with the top of the panoramic telescope.
- (8) Level the bubbles of the telescope mount and refer the telescope to the junction of the pin with the muzzle. Adjust the tube elevation and turn the azimuth micrometer knob until, with the bubbles level, the horizontal and vertical hairs of the telescope are exactly on the junction of the pin with the muzzle (fig. 61).
- (9) Read the angle from the panoramic telescope to the nearest one-fourth mil. Since

the graduations are to the nearest mil, it is necessary to interpolate to the nearest one-fourth mil. This is the standard azimuth (horizontal) angle for the gun tested.

- (10) With either the range quadrant or gunner's quadrant, measure the elevation of the tube to the nearest one-fourth mil. This is the standard elevation (vertical) angle for the weapon tested.
- (11) With a knife blade or other sharp metal point, scribe lines in the paint on the following parts:
 - (a) Straight across the junction of the cross-leveling segment and the cross-leveling worm housing (3, fig. 45).
 - (b) Straight across the junction of the cross-leveling worm housing and the cross-leveling worm knob shaft (2, fig. 45).
 - (c) Straight across the junction of the rocker and the actuating arm (1, fig. 45 and 2, fig. 46).
 - (d) Straight across the junction of the elevation knob shaft and the bracket (1, fig. 46).

- (12) Fill the scribed lines with red paint and wipe off the excess.

c. Procedure. Once the standard angles have been determined, steps in performing the standard angle method of boresighting are as follows:

- (1) Verify that the parts that move in recoil are in the same position with respect to the nonrecoiling parts as they were when the standard angles were determined.

- (2) Verify that the trunnions are canted not more than 10 mils; if convenient, level the trunnions.
- (3) With adhesive tape, fasten a pin in the left horizontal witness mark so that the pin projects to the left of the muzzle.
- (4) Using the range quadrant or gunner's quadrant, elevate the tube to the standard elevation angle.
- (5) Place the parallax shield on the eyepiece of the telescope.
- (6) Set the standard azimuth angle on the panoramic telescope. Make sure that the red scribe lines are in coincidence and set off the standard azimuth angle on the panoramic telescope.
- (7) If the vertical reticle is not exactly on the junction of the pin and the muzzle, adjust the tangent screws until the vertical reticle is properly alined.
- (8) If the horizontal reticle is not exactly on the junction of the pin and the muzzle, turn the elevating knob of the panoramic telescope until it is properly alined. Adjust the zero of the elevation knob scale so that it is in alinement with the index.

Section III. BASIC PERIODIC TESTS

57. General

Basic periodic tests are performed by the section under the supervision of the battery executive and the artillery mechanic. These tests are performed at the discretion of the unit commander. Suggested

times for performance are once each year if the howitzer is used only for nonfiring training; once every 3 months if the howitzer is fired; as soon as possible after extensive use, accidents, or traversing extremely rough terrain; and whenever the howitzer fires inaccurately for no readily apparent reason. The tests reveal whether or not the on-carriage sighting equipment and certain off-carriage equipment are in correct adjustment. For the on-carriage equipment to be in correct adjustment, the following conditions must be met:

a. The line of sight of the panoramic telescope and of the elbow telescope must be parallel to the axis of the bore.

b. All indexes and scales, except the angle of site scale, must read zero. The angle of site scale must read 3 (300).

c. All bubbles must be in adjustment and level.

d. The sighting equipment must satisfactorily meet all tests described in paragraphs 53, 54, and 56.

e. Prior to all tests of on-carriage fire control equipment it is desirable that the trunnions be level. Leveling the trunnions is most easily accomplished by raising or lowering one trail. The best check that the trunnions are level is accomplished in insuring that the axis of the bore tracks a plumbline as described in paragraph 53*b* (1).

58. Test of Gunner's Quadrant

a. General. The gunner's quadrant must be in proper adjustment before tests and adjustments of other sighting and fire control equipment are conducted. Inspect the shoes of the gunner's quadrant for dirt, nicks, or burrs. Similarly, inspect the level-

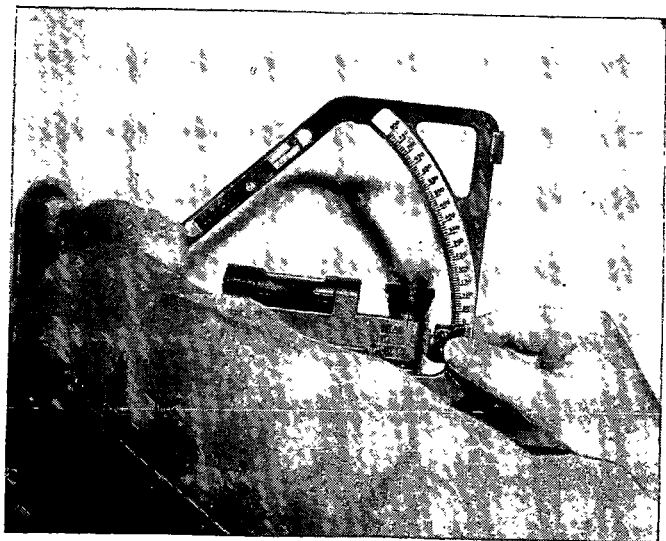


Figure 62. Leveling bubble of gunner's quadrant, normal position, end-for-end test.

ing plates on the upper surface of the breech ring. Dirt, nicks, or burrs on these surfaces will cause the instrument to give inaccurate readings.

b. End-for-End Test.

- (1) Set both the index arm and micrometer scale of the gunner's quadrant at zero, making sure the auxiliary indexes match.
- (2) Place the quadrant on the leveling plates of the breech ring, the line-of-fire arrow pointing toward the muzzle, and center the quadrant bubble by turning the elevating handwheel (fig. 62).
- (3) Reverse the quadrant on the leveling plates (turn it end-for-end). If the bubble re-

centers, the quadrant is in adjustment and the test is completed.

(4) If the bubble does not recenter, try to center it by turning the micrometer knob.

(a) If bubble centers, read black figures and divide by two. This is the correction.

(b) Place correction on micrometer; level tube using elevation handwheel.

(c) Check by again reversing the quadrant. Bubble should center.

(5) If bubble doesn't center as in (4) above, move the arm down one graduation (10 mils).

(a) Turn micrometer until bubble centers.

(b) Take reading on micrometer, add 10 to it, and divide sum by 2. This is the correction.

(c) Place this reading on micrometer, leaving the arm at minus 10; level tube with elevation handwheel.

(d) Check by reversing quadrant on seats. Bubble should center.

(e) Quadrant should be sent to ordnance if correction of error amounts to more than plus or minus 0.4 mil.

c. Micrometer Test.

(1) Set the index arm to read 10 mils on the graduated arc and set the micrometer scale at zero.

(2) Place the quadrant on the leveling plates on the breech ring, the line-of-fire arrow pointing toward the muzzle, and center the quadrant bubble by elevating the tube.

- (3) Set the index arm at zero on the graduated arc and turn the micrometer one revolution to read 10 mils.
- (4) Reseat the quadrant on the leveling plates. The bubble should center.

Caution: Do not disturb the laying of the tube.

- (5) If the bubble does not center, the micrometer is in error and must be adjusted by ordnance personnel.

d. Comparison Test. Compare readings taken at low, medium, and high elevations with all of the gunner's quadrants of a battery on a *single* howitzer whose quadrant seats have been accurately cross-leveled. Any quadrant differing from the average by more than 0.4 mil at any elevation should be sent to ordnance for adjustment.

e. Correction. When a gunner's quadrant requires a correction as determined by the end-for-end test, this correction is not carried during firing but is applied only when making sight tests and adjustments.

59. Test of Range Quadrant

a. Cross-Level Tests.

- (1) The howitzer and carriage being level (axis of bore and axis of trunnions), center the cross-level bubble.
- (2) Turn the elevation knob throughout its limits of motion.
- (3) The cross-level bubble should remain centered to within one-half vial graduation; if it does not, the level vial is incorrectly

alined and the weapon should be sent to an ordnance unit for adjustment.

b. Pivot Azimuth Alinement Test.

- (1) Place the breech and muzzle boresights in their proper positions in the tube.
- (2) Center the previously tested cross-level bubble.
- (3) Elevate and depress the tube, checking to see that the boresights track a plumbline placed in front of the tube; at the same time, watch the cross-level bubble.
- (4) The bubble should remain centered to within one-half vial graduation.
- (5) If the bubble moves off center in excess of this amount, the pivot is not alined in azimuth with the tube; send the weapon to an ordnance unit for adjustment.

c. Pivot Vertical Alinement Test.

- (1) Level the tube using the previously tested gunner's quadrant.
- (2) Center the longitudinal bubble by turning the angle of site micrometer knob.
- (3) Operate the cross leveling knob throughout the limits of the motion; the longitudinal-level bubble should remain centered.
- (4) If the bubble moves off center in excess of one-half vial graduation, either the pivot is not alined vertically with the tube or the level vial is not correctly alined; send the weapon to an ordnance unit for adjustment.

d. Comparison Test.

- (1) Compare the readings indicated by the gunner's quadrant with those on the elevation

quadrant at low, medium, and high elevations of the tube.

- (2) If the two instruments do not agree at all elevations, send the weapon to an ordnance unit for adjustment.

e. Angle of Site Scale Test. Level the tube with the gunner's quadrant, cross-level the range quadrant, and set the scales at zero. Center the longitudinal-level bubble by turning the angle of site micrometer knob. The angle of site scale should read 3 (300) and the angle of site micrometer should read zero; if they do not, adjust the scales.

60. Ordnance Check

It is not contemplated that using units will have the necessary facilities, tools, or skilled mechanics to perform the more precise tests and adjustments of sighting and fire control equipment. When deficiencies recur or when defects cannot be corrected in the field, ordnance checks should be scheduled.

61. Fuze Setters

a. General. Examine the stop which fits into the slot in the movable time ring and the adjusting pawl which engages the notch in the fixed fuze ring to see that their edges are not burred or bent. Depress the adjustable pawl against its spring to see that the movement of the pawl is free. In the following test be sure to test the fuze setter with the fuze for which it is designed; the time scale on the fuze setter must have the same graduations as the time ring on the fuze.

b. Time Scale Test. Set the corrector to 30 and

set any convenient time on the time scale. Test the time scale of the fuze setter by setting several fuzes.

Caution: Before setting a fuze, make sure that the T- and C-screws (of the fuze setter) are tight to prevent any slipping of the scale indexes when the handle of the fuze setter is rotated. The time set on the fuze should agree with the time setting on the fuze setter within one-fourth of the smallest graduation on the fuze time ring. The tolerance amounts to 0.05 second for fuzes having 0.2-second graduations, and 0.125 second for fuzes having 0.5-second graduations. If the fuzes set do not agree with the time set on the fuze setter, repeat the test as a check with a different setting. If the fuzes set still do not agree with the fuze setter, refer the instrument to ordnance for adjustment.

Caution: Do not set any live fuze more than twice. The fuze from a dud must never be used. Reset all fuzes to SAFE and replace the safety wire or cotter pin.

CHAPTER 8

MAINTENANCE AND INSPECTIONS

62. General

Maintenance and inspection are essential to insure that the howitzer section is prepared to carry out its mission immediately. Systematic maintenance and inspection drills provide the best insurance against unexpected breakdown at the critical moment when maximum performance is essential.

63. Disassembly, Adjustment, and Assembly

Disassemblies and adjustments of the weapon authorized to be performed by battery personnel are prescribed in TM 9-325, supplemented by instructions contained in Department of the Army supply manuals ORD 7 SNL C-21, ORD 8 SNL C-21, and ORD 9 SNL C-21. No deviation from these procedures is permitted except when authorized by the responsible ordnance officer.

64. Records

a. The principal records pertaining to the weapon are the Weapon Record Book (DA Form 9-13), a field report of accidents (AR 385-63), and the unsatisfactory equipment report (DA Form 468). Information on the purpose and use of these records may be found in the forms themselves.

b. The chiefs of sections, battery executive, and battery commander also should keep semipermanent

records on their weapons for information and guidance.

65. Maintenance

For detailed instructions concerning maintenance of the 105-mm howitzer see TM 9-325 and LO 9-325. For detailed instructions concerning maintenance of the vehicle being used as a prime mover, see the technical manuals and lubrication orders pertaining to that vehicle.

66. Inspections

Regular inspections are required to insure that materiel is maintained in serviceable condition.

a. The chief of section is responsible for the equipment within his section. He should inspect it thoroughly each day. If he sees the need for repair or adjustment, he notifies the battery executive immediately so that the necessary action can be taken.

b. The executive, accompanied by the artillery mechanic, should make a daily spot-check inspection. Each day he should inspect different parts of the weapons, thereby insuring complete coverage every few days. At least once a month, the executive should make a thorough mechanical inspection of the weapons, auxiliary equipment, tools, and spare parts.

c. Battery, battalion, and higher commanders should make frequent command inspections to assure themselves that the equipment in their commands is being maintained at prescribed standards of condition, appearance, and completeness.

d. For details on inspecting the 105-mm howitzer see TM 9-325. For details on inspecting the vehicle

being used as a prime mover see the appropriate technical manual for that vehicle. Deficiencies found during inspections should be remedied promptly.

e. Duties of individuals in performing the necessary inspections and maintenance of the howitzer are outlined in the tables IV and V. Work will become routine, thorough, and rapid if the drills outlined in these tables are followed. When the section is reduced in strength the chief of section must reassign duties to insure that all maintenance steps are completed.

67. Inspection Duties Before Operation (March)

The inspection performed before operation is a final check on materiel made prior to leaving the motor park for training in the field, the bivouac area for combat, or before displacement. After inspection, and when all deficiencies have been corrected, the section is ready to go into action.

68. Inspection Duties During the March

The inspection performed during operation is a constant check on the operation of materiel and the security of equipment to insure that all materiel goes into combat in the best possible condition. The responsibilities and duties are as shown in *a* through *d* below:

a. Chief of Section.

- (1) Rides in cab with driver and supervises march discipline.
- (2) Assigns duties for air defense and anti-mechanized security.

- (3) Observes prime mover instruments and controls for proper functioning and listens for unusual noises indicating malfunctioning of the vehicle or weapon.

b. Gunner.

- (1) Listens for abnormal or unusual noises and observes towed load for security.
- (2) Signals chief of section in case of malfunction.

c. Nos. 1 through 6 Inclusive.

- (1) Perform duties as air defense and anti-mechanized security sentries when assigned by chief of section.
- (2) Listen for abnormal or unusual noises indicating malfunction of vehicle or weapon.

d. Driver. Performs *during operation* duties as prescribed in TM 21-305.

69. Inspection Duties During Halt

The inspection at the halt is made to insure that the howitzer and prime mover are in good condition. This inspection includes checks of items which cannot be checked during the march and is performed as soon as a halt is made. The chief of section, on being told the length of halt, will divide halt time between relief of personnel and maintenance of prime mover and howitzer. Duties are as shown in table V.

70. Inspection Duties Prior To and During Firing

Inspection before and during firing is a continuing inspection to insure proper functioning of materiel. No command is necessary; each member of the section performs appropriate inspections

throughout prefiring and firing periods as shown in *a* through *e* below :

a. Chief of Section.

- (1) Supervises and commands section as prescribed in chapters 4 and 5.
- (2) Supervises servicing of recoil system and testing and adjustment of sighting and fire control equipment prior to firing.

b. Gunner.

- (1) Tests and adjusts sighting and fire control equipment prior to firing, provided sufficient time is available.
- (2) Performs inspection duties in firing as prescribed in chapters 4 and 5.

c. No. 1.

- (1) Tests and adjusts elbow telescope prior to firing.
- (2) Performs inspection duties in firing as prescribed in chapters 4 and 5.

d. No. 2 through 6. Perform appropriate inspection as prescribed in chapters 4 and 5, and any other duties directed by chief of section.

e. Driver. Moves his vehicle to the motor park, usually under the direction of the first sergeant and performs *after operation* duties as prescribed in appropriate technical manual for the prime mover.

71. Inspection Duties and Maintenance After Operation

After operation, the howitzer is immediately given servicing and maintenance checks necessary to prepare for further sustained action or to determine the need for maintenance by higher echelons. These operations may be performed in the motor park,

Table IV. Inspection Duties Before Operation (March)

Sequence	Chief of section	Gunner	Number 1	Number 2	Number 3	Number 4	Number 5	Number 6	Driver
1	Supervises inspections by members of the gun section in all sequences.	Inspects condition, completeness, contents, and security of section chest.						Assists the prime mover driver in inspection and maintenance of his vehicle when directed to do so by the chief of section. Loads ammunition in prime mover and trailer as directed.	Performs "before operation" duties as prescribed in appropriate technical manual for his prime mover, assisted by cannoneer No. 6 when so directed by chief of section.
2	Verifies that howitzer is properly coupled.	Releases left wheel handbrake.	Releases right wheel handbrake before coupling.	Inspects condition and security of rammer staff.					
3	Verifies that handbrakes are released.			Disconnects and removes light system from howitzer.	Inspects overall cover for torn or worn places and for broken or missing fastenings.				
4	Inspects recoil system for signs of oil leakage.	Remove breech end of overall cover.		Inspects condition and security of trail handspike.		Remove muzzle end of overall cover.			
5	Supervises the gunner in making tests and adjustments of sighting and fire control equipment.	Inspects condition and security of sighting and fire control equipment, except elbow telescope.	Inspects elbow telescope for condition and security. Inspects breechblock, firing mechanism, chamber, and bore for cleanliness, freedom from foreign matter, and lubrication.	Inspects tires for wear, bruises, cuts, stones in treads, and for low air pressure. Inspects wheels for loose or missing nuts, hubcap screws, and valve caps.	Inspects drawbar to see that it is in proper position and securely locked.	Inspects left axle lock for proper fastening in traveling position.	Inspects right axle lock for proper fastening in traveling position.		
6	Inspects oil index to insure that proper reserve of oil is present in the recoil system (TM 9-325).					Inspects cradle lock strut for adjustment and fastening.	Inspects condition and security of aiming posts on trails.		
7	Inspects ammunition for lot number, condition, and stowage.			Determines presence of ample supply of cleaning and preserving material.	Inspects carriage for loose parts, condition of tube fittings, and for cracked or broken welds.	Assures that left latch is holding bottom shield flap in traveling position.	Assures that right latch is holding bottom shield flap in traveling position.		
8	Verifies presence of proper supply of gasoline, oil, water, and emergency rations.					Inspects cradle traveling locks for adjustment.	Inspects barrel locking ring and locking nuts for security.		
9	Inspects loading of section equipment for completeness and security.	Inspects position and fastening of shield.			Inspects for grease and oil leakage on or under carriage.	Cleans and oils elevating rack and pinions.	Cleans and greases recoil slides.		
10	Verifies presence of technical manuals and lubrication orders for prime mover and howitzer, trip ticket, driver's accident report form, vehicle identification card, and gun book.	Replace breech end of overall cover.				Replace muzzle end of overall cover.	Replaces muzzle cover.		
11			Inspects condition and fastening of trail traveling lock and latch.	Replaces and connects light system on howitzer.	Loads ammunition in prime mover and trailer.	Load ammunition in prime mover and trailer.			
12	Receives reports of personnel of his section upon completion of their duties in inspection.	Reports, "Gunner ready."	Reports, "No. 1 ready."	Reports, "No. 2 ready."	Reports, "No. 3 ready."	Reports, "No. 4 ready."	Reports, "No. 5 ready."	Reports, "No. 6 ready."	Reports, "Driver ready."
13	Reports to battery executive when section personnel have completed their duties, "Sir, No. (so-and-so) in order," or reports any defects which the section cannot remedy without delay or assistance.								

Table V. Inspection Duties During Halt

Sequence	Chief of section	Gunner	Number 1	Number 2	Numbers 3-6 inclusive	Driver
1	Commands PERFORM HALT INSPECTION. Supervises inspection and maintenance at halt. Insures that personnel remain to right of left wheel line except to inspect left wheels.	Inspects for presence, condition, and security of sighting equipment, covers, staff sections, aiming posts, trail handspikes, and section chest.	Inspects coupling of howitzer to prime mover.	Inspects tires and wheels. (Inspects tires for wear, bruises, cuts, stones in treads, and for correct air pressure.) Inspects wheels for loose or missing nuts, hubcap screws, valve caps, and overheated wheel bearings.	Perform duties as prescribed by chief of section.	Performs <i>at halt</i> duties as prescribed for his vehicle.
2			Inspects trail traveling lock and latch for condition and fastening.			
3			Inspects connection, functioning, and mounting of light system and inspects fastenings of overall cover.			
4	Receives reports of personnel upon completion of their duties.	Reports, "Gunner ready."	Reports "No. 1 ready."	Reports "No. 2 ready."	Reports "No. (so-and-so) ready."	Reports "Driver ready."
5	Reports to battery executive when inspection is completed, "Sir, No. (so-and-so) in order," or reports any defects that the section cannot remedy without delay.					

Table VI. Inspection Duties and Maintenance After Operation

Sequence	Chief of section	Gunner	Number 1	Number 2	Number 3	Number 4	Number 5	Number 6	Driver
1	Commands INSPECT EQUIPMENT. Supervises detailed inspection and maintenance of howitzer in all sequences.	Inspects for presence of all sighting and fire control equipment, cleans, secures and, to the extent that he is authorized, lubricates them.	Inspects, cleans, and secures elbow telescope.	Removes, cleans, and replaces rammer staff and trail handspike.				As directed by the chief of section. May assist prime mover driver in inspection and maintenance or perform other duties as directed by chief of section.	Performs after operation duties as prescribed for his vehicle, assisted by cannoneer No. 6 when so directed by chief of section.
2	Inspects tools' accessories, and equipment for completeness and condition.			Inspects tires and wheels for damage and loose or missing parts; tests air pressure of tires and corrects if it is necessary.					
3	Inspects ammunition for lot number, complete rounds, and general condition.			Removes and cleans light system equipment and stores it in section chest.	Inspects fastenings and general condition of cover.				
4		Remove breech portion of overall howitzer cover.				Remove muzzle portion of overall howitzer cover ----- Remover muzzle cover.			
5	Inspects recoil system for signs of leakage and supervises filling to correct oil reserve when necessary (TM 9-325).	Inspects shield fastenings.	Removes, cleans, oils, and replaces breech mechanism, assisted by section personnel as directed by chief of section.	Clean howitzer and carriage.		Clean howitzer and carriage.			
6	Verifies the presence of and makes current entries in gun book, trip ticket, and other required documents.	Inspects bore and breech mechanism after cleaning.			Lubricates howitzer and carriage.	Lubricates howitzer and carriage.	Removes, cleans, lubricates, and returns aiming posts.		
7	Verifies that there is an ample supply of emergency rations, oil, water, and gasoline.	Checks the contents of the section chest, and inspects for condition of chest and contents.			Inspects carriage for loose or missing nuts, bolts, rivets, and broken welds; looks for excess grease or oil under carriage.				
8		Replace breech portion of overall howitzer cover.			Cleans, lubricates, and returns fuze setter to section chest.	Replaces muzzle cover. ----- Replace muzzle portion of overall howitzer cover.			
9							Properly stores unused cleaning and preserving materials.		
10	Receives reports from members of the section as they complete inspection and maintenance operations.	Reports, "Gunner ready."	Reports, "No. 1 ready."	Reports, "No. 2 ready."	Reports, "No. 3 ready."	Reports, "No. 4 ready."	Reports, "No. 5 ready."	Reports, "No. 6 ready."	Reports, "Driver ready."
11	Reports to battery executive "Sir, No. (so-and-so) in order."								

bivouac area, or combat position. Inspections are as shown in table VI.

72. Duties in Weekly Inspection and Maintenance

In garrison, these duties are performed weekly. On maneuver or in combat, they are performed after each field operation.

a. Chief of Section.

- (1) Supervises section in weekly inspection and maintenance of weapon, tools, accessories, and equipment. See TM 9-325 and LO 9-325 for further details.
- (2) Obtains assistance of the artillery mechanic for operations requiring skill and tools beyond the capabilities of the section.

b. Gunner and Cannoneers Nos. 1 through 5 Inclusive. Perform normal maintenance as directed by the chief of section.

c. Driver and Cannoneer No. 6. When directed to do so by the chief of section, the driver and No. 6 cannoneer assist the motor mechanic in the performance of the prescribed vehicle lubrication and quarterly services.

CHAPTER 9

DECONTAMINATION OF EQUIPMENT

73. General

Equipment which has been contaminated by chemical, biological, or radiological agents constitutes a danger to personnel. *Contamination* is the spreading of an injurious agent in any form and by any means. Persons, objects, or terrain may be contaminated. *Decontamination* is the process of making any contaminated place or object safe for unprotected personnel. This can be done by covering, removing, destroying, or changing into harmless substances the contaminating agent or agents. Generally, only equipment contaminated by persistent agents needs to be decontaminated.

74. Decontamination for Chemical Agents

a. Ammunition. With rags, wipe off visible contamination from projectiles. Apply DANC (decontamination agent, noncorrosive) solution, wipe with gasoline-soaked rag, then dry. If DANC is not available, scrub with soap and cool water. Slurry (equal weights of water and chloride of lime) can be used on contaminated ammunition containers, but it must not be allowed to penetrate to the ammunition itself.

b. Instruments. If instruments are exposed to corrosive gases, clean as soon as possible with alcohol (or gasoline, if no alcohol is available), and apply

a thin coat of light machine oil. Or, use a rag dampened with DANC, dry with a clean rag, and then apply a coat of machine oil.

Caution: DANC injures plastic or hard rubber surfaces.

c. Weapons. Remove dirt, dust, grease, and oil. Do not apply wet mix but allow surfaces to air after soil and dirt have been removed. DANC can be used on all metal surfaces except the bore. Boiling water, cleaning solvent, or repeated applications of gasoline on swabs are also effective. If an emergency requires the use of gasoline-soaked swabs (FM 21-40), extreme care must be taken to insure that the gasoline does not spread the contamination and that it does not remain in liquid or vapor form. Excess gasoline could ignite when the gun is fired. After decontamination, weapons are dried and oiled.

d. Automotive Equipment. Light contamination from spray can be decontaminated by aeration alone. For heavier contamination use DANC on interior or exterior surfaces which personnel are likely to touch. For larger area decontamination, wash vehicle with water and scrub painted surfaces with soap and water.

75. Decontamination for Biological Agents

a. Biological decontamination is the process of destroying biological agents or preventing them from reaching personnel.

b. A material employed to destroy biological agents must be effective against a multiplicity of organisms, rapid in action, nontoxic, and available in quantity at a reasonable price.

c. The standard chemical decontaminants; chloride of lime, slurry, DANC solution, soap and water, and commercially produced disinfectants, may be used for biological decontamination.

76. Decontamination for Radiological Agents

a. Unlike war gases, radioactive contaminants cannot be made safe by chemical action. They must be removed or shielded if it is impractical to wait for natural decay.

b. Radiological decontamination is the process of reducing the hazard of radioactivity by removal and disposal of the contamination, or by shielding against the radiation.

77. References

For further information on decontamination see FM 21-40, TM 3-220, and TF 3-1407.

CHAPTER 10

DESTRUCTION OF EQUIPMENT

78. General

a. Tactical situations may arise when it becomes necessary to abandon equipment in the combat zone. In such a situation, all abandoned equipment must be destroyed to prevent its use by the enemy.

b. *The destruction of equipment subject to capture or abandonment in the combat zone will be undertaken only upon authority delegated by division or higher commanders.*

c. All batteries must prepare plans for destroying their equipment in order to reduce the time required should destruction become necessary. The principles to be followed are—

- (1) Plans for destruction of equipment must be adequate, uniform, and easily carried out in the field.
- (2) Destruction must be as complete as the available time, equipment, and personnel will permit. Since complete destruction requires considerable time, the more essential parts are destroyed first.
- (3) The same essential parts must be destroyed on all like units to prevent the enemy from constructing complete units from damaged ones.
- (4) Spare parts and accessories must be given

the same priorities as the parts installed on the equipment.

79. Methods

To destroy equipment adequately and uniformly, all personnel of the unit must know the plan and priority of destruction and be trained in the methods of destruction.

80. References

For detailed information on destruction of barrel assembly and recoil mechanism, carriage or mount, tires, and fire control equipment, see TM 9-325; for ammunition, see TM 9-1901. For destruction of vehicle, see the technical manual appropriate to the vehicle being used as a prime mover.

CHAPTER 11

SAFETY PRECAUTIONS

81. General

Safety precautions to be observed in training are prescribed in AR 385-63. Additional information is found in FM 6-140, TM 9-325, and TM 9-1900. The more important safety precautions are summarized in the following paragraphs.

82. Ammunition

a. All ammunition at the firing position must be so placed that it is protected against explosion in case of accident at the gun position. Flames and explosives materials such as gasoline must be kept away from the ammunition. Ammunition should be protected from direct rays of the sun by use of a tarpaulin or other suitable covering.

b. Battery personnel must not attempt to disassemble fuzes or remove primers from rounds.

c. If for any reason a round is not fired after the time fuze has been set, the fuze must be reset to SAFE before it is restowed.

d. All rounds not fired which have been prepared for firing must be checked by the chief of section, to insure that all seven powder increments are present in proper order and condition, and that they are of the proper lot number. He also verifies that the lot number of the ammunition corresponds to the lot number on the container. A battery officer must cer-

tify that ammunition has been properly reassembled. For further details, see FM 6-140.

83. Misfires

a. In the event of a misfire, make two more attempts to fire the piece. If it does not fire, wait 2 minutes from the time of the last attempt before the executive commands UNLOAD.

b. Upon the command UNLOAD, No. 1 opens breech; No. 2 removes only the cartridge case, and inspects the primer. If the primer is dented, a faulty primer is indicated and the cartridge case is replaced. Take care to segregate the faulty cartridge case from servicable cartridge cases. If the primer is not dented, a faulty firing mechanism is indicated.

c. See TM 9-325 for action to be taken in case the indent on the primer is light or if there is no indent, indicating that the firing lock is not functioning properly.

84. Drill and Firing

a. Keep the weapon unloaded except when firing is imminent.

b. Members of the gun section should pass in rear of the gun when going from one side to another.

c. Personnel must stay a safe distance from the breech to prevent injury during recoil.

d. During firing, personnel should use cotton or earplugs in their ears to protect eardrums against injury.

e. In training there must always be a safety officer for each artillery unit firing. For duties of the safety officer see FM 6-40.

APPENDIX I

REFERENCES

1. Miscellaneous Publications

- AR 320-5_____ Dictionary of United States Army Terms.
- AR 385-63_____ Regulations for Firing Ammunition for Training, Target Practice, and Combat.
- AR 600-70_____ Badges.
- AR 611-201_____ Manual of Enlisted Military Occupational Specialties.
- AR 750-5_____ Maintenance Responsibilities and Shop Operation.
- ASubjScd 6-3_____ Cannoneer and Rocketeer Instruction.
- ATP 6-100_____ Army Training Program for Field Artillery Units.
- ATT 6-1_____ Field Artillery Howitzer Gun Battery.
- ATT 6-5_____ Light and Medium Field Artillery Battalion.
- ATT 6-116_____ Field Artillery Battalion, 105-mm and 155-mm, Towed and Self-Propelled.
- ATT 6-117_____ Field Artillery Howitzer Battery 105-mm or 155-mm.
- DA Pam 108-1_____ Index of Army Motion Pictures, Film Strips, Slides, and Phono Recordings.
- DA Pam 310-series__ Military Publications.
- FM 5-15_____ Field Fortifications.
- FM 5-20_____ Camouflage, Basic Principles and Field Camouflage.
- FM 5-22_____ Camouflage Materials.
- FM 5-25_____ Explosives and Demolitions.
- FM 6-21_____ Division Artillery.
- FM 6-40_____ Field Artillery Gunnery.

Qualification Tests for Specialists, FM 6-125-----	Field Artillery.
FM 6-140-----	The Field Artillery Battery.
FM 21-5-----	Military Training.
FM 21-40-----	Small Unit Procedures in Atomic, Biological, and Chemical Warfare.
FM 25-10-----	Motor Transportation, Operations.
TF 3-1407-----	Decontamination Procedure.
TM 3-220-----	Decontamination.
TM 5-200-----	Camouflage Nets and Net Sets.
TM 9-325-----	105-mm Howitzer M2A1; Carriages M2A1 and M2A2; and Combat Vehicle Mounts M4 and M4A1.
TM 9-575-----	Auxiliary Sighting and Fire Control Equipment.
TM 9-1007-----	Materials Used for Cleaning, Preserving, Abrading, and Cementing Ordnance Materiel and Related Materials, Including Chemicals, Lubricants, Indicators, and Hydraulic Fluids.
TM 9-1527-----	Gunner's Quadrants M1 and M1918, and Machine Gun Clinometer M1917.
TM 9-1545-----	Telescope Mounts, and Range and elevation Quadrants for Motor Carriages, Field Artillery, and Anti-aircraft Artillery.
TM 9-1590-----	Fuze Setters.
TM 9-1900-----	Ammunition, General.
TM 9-1901-----	Artillery Ammunition.
TM 9-2300-----	Artillery Materiel and Associated equipment.
TM 9-2810-----	Tactical Motor Vehicle Preventive Maintenance, Supply, and Inspection, and Training Procedures.
TM 9-3007-----	105-mm Howitzer M2A1; 105-mm Howitzer Recoil Mechanisms M2A1, M2A2, and M2A3; 105-mm Howitzer Carriages M2A1 and M2A2; and

105-mm Howitzer Mounts M4 and
M4A1.

TM 9-6111----- Panoramic Telescopes, M1, M12,
M12A2, M12A5, and M12A6.

TM 21-300----- Driver Selection and Training
(Wheeled Vehicles).

TM 21-305----- Manual for the Wheeled Vehicle
Driver.

2. DA ORD Supply Manuals:

SNL C-21----- Howitzer, 105-mm, M2A1; Carriage
Howitzer, 105-mm, M2A1 and M2A2.

SM 9-2-1315----- Ammunition, 75-mm Through 125-mm.

SM 9-2-1345----- Land Mines.

SM 9-2-1390----- Fuzes and Primers.

APPENDIX II

TRAINING

Section I. GENERAL

1. Purpose and Scope

The purpose of this appendix is to present the minimum requirements for training the personnel of a howitzer section in the performance of their duties in service of the piece. It includes general information on the conduct of training, a minimum training schedule, and tests to be given for the qualification of gunners.

2. Objectives

The objectives are speed in training cannoneers in their individual duties; and, through drill, to weld them into an effective, coordinated team able to function efficiently in combat. During training, supervisors should keep in mind the proficiency sought by Army Training Tests (ATT) 6-1, 6-5, 6-116, and 6-117. Maximum efficiency is attained through continuous drills.

3. Conduct of Training

a. Training will be conducted in accordance with the principles laid down in FM 21-5. Its goal should be the standards set forth in AR 611-201, ATP 6-100, and FM 6-125.

b. Individual training is conducted by noncommissioned officers as far as practicable. Officers are

responsible for training plans, for conducting unit training, and for supervising and testing individual training.

c. Throughout training, the application of prior instruction to current training must be emphasized.

d. A record of the training received by each individual should be kept on a progress card maintained by each chief of section for each man in his section. This card should show each period of instruction attended, tests taken, and progress made. Progress cards should be inspected frequently by the battery executive to make sure that they are being kept properly and to determine the state of training. *Requiring the chief of section to keep these records emphasizes his responsibility toward his section.*

e. The necessity for developing leadership and initiative in noncommissioned officers must be emphasized constantly throughout training.

Section II. MINIMUM TRAINING SCHEDULE

4. General

The training schedule outlined in paragraph 6 of this appendix is a guide to meet the minimum training requirements for personnel of a howitzer section in subjects covered in this manual.

5. Individual Periods

a. Individual periods of training in service of the piece should be arranged, along with other battery training, into a balanced training program taking into consideration the basic principles of training.

b. In general, except for service practice, periods on any subject should not be longer than 1 hour.

c. Howitzer drill periods should be preceded and followed by periods on subjects that will be logically related to the drill. For example, precede a period of howitzer drill with a period of testing and adjustment of sighting and fire control equipment, and follow it with a period on inspection and maintenance drills.

d. Army Subject Schedule 6-3 provides uniform guidance in the conduct of cannoneer training.

e. TM 9-325 provides information on which to base periods of instruction on description, characteristics, and functioning of the howitzer, familiarization to include breech and firing mechanism, barrel assembly and slides, recoil mechanism, equilibrators, elevating mechanism, sighting and fire control equipment; and field assembly and malfunction. These should be included in the battery training schedule, closely allied with the training in service of the piece.

6. Schedule

Method	Hours	Subject	Text references	Training aids and equipment
C, D, PW.	1	Organization and composition of gun section; general duties of individuals; formation of gun section.	Pars. 4-8, incl.	Gun and prime mover.
C, D, PW.	1	Posts and posting of cannoneers; changing posts; mounting and dismounting.	Pars. 9-13, incl.	Do.
C, D, PW.	2 (1 hour periods).	Coupling and uncoupling; prepare for action, and march order; movement of gun by hand.	Pars. 14-19, incl.	Do.
C, D, PW.	24 (½ hour periods).	Gun drill, duties in firing, indirect laying.	Pars. 22-30, incl; 44; 47-50 incl.	TOE equipment.
C, D, PW.	9 (½ hour periods).	Gun drill duties in firing, direct laying.	Pars. 31-43, incl.	Do.
C, D, PW.	6 (1 hour and ½ hour periods).	Testing and adjustment of sighting and fire control equipment.	Pars. 53-61, incl.	Do.

Method	Hours	Subject	Text reference	Training aids and equipment
C, D, PW.	2 (½ hour periods).	Aiming post displacement correction.	Par. 45-----	TOE equipment, black-board, and chalk.
C, D, PW.	4 (1 hour periods).	Inspections and maintenance drills	Pars. 62-72, incl.	TOE equipment.
C, D, PW.	1	Decontamination of materiel-----	Pars. 73-77, incl.	Decontamination equipment; TOE equipment.
C, D, PW.	1	Destruction of materiel to prevent use by the enemy.	Pars. 78-80, incl.	Demolition and TOE equipment.
C, D-- PW---	1 16 (4 hour periods).	Safety precautions----- Service, practice, indirect laying---	Pars. 81-84, incl. Pars. 22-30, incl; 44; 46; 47-50. incl.	TOE equipment. TOE equipment.
PW---	4	Service, practice, direct laying----	Pars. 31-43, incl.	Do.
C, PW.	6 (1 hour periods).	Review and tests of subjects previously covered.	All previous references.	Do.

C—conference; D—demonstration, PW—practical work (78 hrs.).

Section III. TESTS FOR QUALIFICATION OF GUNNERS

7. Purpose and Scope

This section prescribes the tests to be given in the qualification of gunners. The purpose of the test are twofold—

a. To provide a means of determining the relative proficiency of the individual artillery soldier in the performance of the duties of the gunner, 105-mm howitzer M2 and modifications. *The tests will not be a basis for determining the relative proficiency of batteries or higher units.*

b. To serve as an adjunct to training.

8. General Instructions

a. *Standards of Precision.* The candidate will be required to perform the tests in accordance with the standards listed below:

- (1) Scale settings must be exact and matching indexes must be brought into coincidence.
- (2) Level bubbles must be exactly centered.
- (3) The vertical reticle of the panoramic telescope must be alined on the left edge of the aiming post or on exactly the same part of the aiming point each time the piece is laid.
- (4) Final motions of azimuth and elevation setting knobs, as well as traversing and elevating handwheels, must be made in the appropriate direction. For elevating, the final motion of the handwheel should be in the direction of the more difficult movement. Final motion for traversing is from left to right. Final movement of the vertical reticle of the telescope is from left to right.

b. Assistance. The candidate will receive no unauthorized assistance. Each candidate may select authorized assistants as indicated in the tests. In the event a candidate fails any test because of the fault of any assistant, the test will be disregarded, and the candidate will be given another test of the same nature.

c. Time. The time for any test will be the time from the last word of the command to the last word of the candidate's report. The candidate may begin any test after the first word of the first command.

d. Scoring. Scoring will be conducted in accordance with the subparagraphs *Penalties* and *Credit* under each subject. If a test is performed correctly, credit will be given in accordance with the subparagraph *Credit* under each subject. No credit will be allowed if conditions exist as specified in the subparagraphs headed *Penalties*.

e. Preparation for Tests. The howitzer will be prepared for action and the candidate posted at the proper position corresponding to the test being conducted or as indicated in the subparagraphs entitled "Special instructions." The examiner will insure that the candidate understands the requirements of each test and will require the candidate to report "I am ready" before each test.

f. Qualification Scores. Minimum scores required for qualification in the courses are as follows:

<i>Individual classification</i>	<i>Points</i>
Expert gunner	90
First-class gunner	80
Second-class gunner	70

9. Outline of Tests

Para-graph No.	Subject	No. of tests	Points each	Maximum credit
10	Direct laying, panoramic telescope-----	4	2	8
11	Direct laying, elbow telescope-----	4	2	8
12	Indirect laying, deflection only-----	18	2	36
13	Laying for elevation with range quadrant-----	3	2	6
14	Laying for elevation with gunner's quadrant-----	3	2	6
15	Displacement correction-----	2		4
	Part I-----	(1)	3	(3)
	Part II-----	(1)	1	(1)
16	Measuring site to the mask-----	1	4	4
17	Measuring elevation-----	1	4	4
18	Measuring deflection-----	1	4	4
19	Tests and adjustment of sighting and fire control equipment-----	6		10
	Tests 1, 3, 4, and 5-----	(4)	2	(8)
	Tests 2 and 6-----	(2)	1	(2)
20	Materiel-----	3		10
	Tests 1 and 2-----	(2)	3	(6)
	Test 3-----	(1)	4	(4)
Total credit-----				100

10. Direct Laying, Panoramic Telescope

a. Scope of Tests.

- (1) Four tests (two groups of two tests each) will be conducted in which the candidate will be required to execute commands similar to those given in *c* below.

- (2) Tests 1 and 2 (and tests 3 and 4) will be executed as one series of commands.
- (3) The candidate will be tested in the duties of the gunner, using the one-man, one-sight system.

b. Special Instructions.

- (1) A stationary target will be placed approximately 600 meters from the howitzer.
- (2) The fixed azimuth scale and micrometer scale will be set at zero, and indexes on telescope mount will be matched.
- (3) The candidate will be posted as the gunner.
- (4) The weapon will be pointed so that—
 - (a) A shift of approximately 100 mils will be required for tests 1 and 3.
 - (b) It will not be necessary to shift the trails for any of the four tests.
- (5) Laying at the termination of tests 1 and 3 will not be disturbed prior to beginning tests 2 and 4.
- (6) The examiner will announce the assumed direction of the movement of the target at the beginning of tests 1 and 3. The assumed direction of the movement of the target in test 3 will be opposite to that in test 1.

c. Outline of Tests.

Test No.	Examiner commands (for example)	Action of candidate
1 and 3.	TARGET, THAT TANK; LEAD 5, RANGE 600.	Traverses piece until proper lead has been set. Places proper range line of reticle on the center of the visible mass of the target. Centers cross-level bubble. Gives the command FIRE when ready and steps clear.
2 and 4.	RIGHT (LEFT) 10, ADD (DROP) 200.	Same as test 1 above.

d. Penalties. No credit will be allowed if, after each test—

- (1) The azimuth scale has been moved from zero.
- (2) The indexes on the azimuth micrometer have been moved from zero.
- (3) The indexes on the telescope mount are not in coincidence.
- (4) The lead in mils is not set properly.
- (5) The proper range line of the reticle is not on the center of the visible mass of the target.

e. Credit.

Time in seconds, exactly or less than---	4	4½	5
Credit -----	2.0	1.5	1.0

11. Direct Laying, Elbow Telescope

a. Scope of Tests.

- (1) Four tests (two groups of two tests each) will be conducted in which the candidate will be required to execute commands similar to those given in *c* below.
- (2) Tests 1 and 2 (and tests 3 and 4) will be executed as one series of commands.
- (3) The candidate will be tested in the duties of number 1 cannoneer, using the two-man, two-sight system.

b. Special Instructions.

- (1) A stationary target will be placed approximately 600 meters from the piece.
- (2) For tests 1 and 3, the field of view of the telescope will be placed on the target, with the correct range line more than 100 meters off the target.
- (3) The laying of the piece will not be disturbed after tests 1 and 3.

c. Outline of Tests.

Test No.	Examiner commands (for example)	Action of candidate
1 and 3.	TARGET, THAT TANK; RANGE 500.	Places proper reticle line for announced range on the center of the visible mass of the target. Calls "Set" and steps clear.
2 and 4.	ADD (DROP) 400----	Same as test 1 above.

d. Penalties. No credit will be allowed if, after each test—

- (1) The correct range line is not on the center of the visible mass of the target.
- (2) The range lines of the reticle are not approximately horizontal.

e. Credit.

Time in seconds, exactly or less than--	1½	1¼	2
Credit -----	2.0	1.5	1.0

12. Indirect Laying, Deflection Only

a. Scope of Tests. Eighteen tests will be conducted in which the candidate will be required to execute commands similar to those given in *c* below. Tests 1 through 4 (and tests 5-9, 10-13, and 14-18) will be executed as one series of commands.

b. Special Instructions.

- (1) Commands will not necessitate shifting trails.
- (2) The examiner will select a suitable aiming point and identify it to the candidate.
- (3) Commands for special corrections will be given *only* in the tests indicated in the examples in *c* below.
- (4) The command for new deflections for each test will be within the following prescribed limits.

Test No.	Maximum change (mils)	Minimum change (mils)
2 and 11	180	140
3 and 12	90	70
4 and 13	40	20
7 and 16	100	60
8 and 17	50	30
9 and 18	20	10

- (5) The piece will be laid with correct settings at the conclusion of each test before proceeding with the next test.
- (6) Aiming posts will be set out at prescribed deflection and distances for these tests.
- (7) Special corrections for deflection may be omitted from the test if the unit SOP requires that deflection corrections be applied at the fire direction center.
- (8) The examiner will designate the section number of the weapon to be used. The examiner will announce special corrections in deflection to be applied by the candidate.

c. Outline of Tests.

Test No.	Examiner commands (for example)	Action of candidate
1 and 10.	SPECIAL CORRECTIONS, DEFLECTION 2890, NO. 1 LEFT 7.	Sets deflection and applies special correction. Centers cross- and longitudinal-level bubbles. Traverses piece until vertical hair is on left edge of aiming posts. Checks centering of bubbles. Re-lays if necessary. Calls "Ready" and steps clear.
2 and 11.	DEFLECTION 2760-----	Sets deflection change. Leaves correction on gunner's aid. Lays on aiming posts. Checks centering of bubbles. Re-lays if necessary. Calls "Ready" and steps clear.
3 and 12.	DEFLECTION 2835-----	Same as test 2 above.
4 and 13.	NO. 1, RIGHT 4-----	Same as test 2 above, but changes gunner's aid to right 4 and resets deflection 2835 opposite index.
	At conclusion of test 4 (13) give CEASE FIRE, END OF MISSION. (No time considered for this operation.)	Gunner moves gunner's aid to zero.

Test No.	Examiner commands (for example)	Action of candidate
5 and 14.	AIMING POINT, CHURCH STEEPLE, REFER.	Refers telescope to church steeple. Reads deflection and calls "Number 1, deflection (so much)."
6 and 15.	DEFLECTION 2800, REFER.	Slips the slipping azimuth micrometer scale to 2800. Verifies that vertical reticle is on church steeple. Calls "Number 1, deflection 2800." Steps clear.
7 and 16.	SPECIAL CORRECTIONS DEFLECTION 2920 NO. 1 LEFT 7.	Same as test 1 above.
8 and 17.	DEFLECTION 3040-----	Same as test 2 above.
9 and 18.	DEFLECTION 3080-----	Same as test 2 above.

d. Penalties.

- (1) No credit will be allowed if, after each test—
 - (a) The deflection is set incorrectly.
 - (b) The cross-level or longitudinal-level bubble is not centered.
 - (c) The vertical hair of the telescope is not on the aiming point or left edge of aiming posts, as the case may be.
- (2) No credit will be allowed if the last motion of the traverse was not made to the right.

e. Credit. Time in seconds, exactly or less than—

Tests 1, 10, 6, and 15 each.....	12	13	14
Other tests, each.....	8	9	10
Credit.....	2.0	1.5	1.0

13. Laying for Quadrant (Elevation) Elevation with Range Quadrant

a. Scope of Tests. Three tests will be conducted in which the candidate will be required to execute commands similar to those given in *c* below.

b. Special Instruction.

- (1) Each test will require a change of settings and the accompanying laying of the tube in elevation within the following limits:
Quadrant elevation, 35 to 65 mils.
- (2) Command for quadrant (elevation) elevation for tests 2 and 3 will not be made in multiples of 5 mils.
- (3) Special corrections will be applied by the candidate if required by unit SOP. Otherwise they may be omitted.
- (4) The candidate will be posted as No. 1 cannoneer.

c. Outline of Tests.

Test No.	Examiner commands (for example)	Action of candidate
1	QUADRANT 275.....	Sets site 300 and announced quadrant elevation. Centers cross-level and longitudinal-level bubbles. Calls "Set" and steps clear.
2	QUADRANT 336.....	Same as test 1 above.
3	SPECIAL CORRECTIONS, NO. 1 UP 2, QUADRANT 333.	Same as test 1 above.

d. Penalties.

(1) No credit will be allowed if, after each test—

(a) The quadrant is not set accurately.

(b) The cross-level or longitudinal-level bubble is not centered.

(2) No credit will be allowed if the last movement of the tube was not in the direction in which it is most difficult to turn the elevating handwheel.

e. Credit.

Time in seconds, exactly or less than—	6%	7%	8%
Credit	2.0	1.5	1.0

14. Laying for Elevation with Gunner's Quadrant

a. Scope of Tests. Three tests will be conducted in which the candidate will be required to execute commands similar to those given below.

b. Special Instructions.

- (1) The gunner's quadrant will be set at zero for the first test.
- (2) Each succeeding test will require a change of quadrant elevation setting within the limits of 30 to 60 mils.
- (3) The candidate will be posted to the left of and facing the breech, with the gunner's quadrant in his hand.
- (4) An assistant, selected by the candidate, will be posted to the right of the breech to operate the elevating handwheel.

c. Outline of Tests.

Test No.	Examiner commands (for example)	Actions of candidate
1----	QUADRANT 180-	Sets quadrant elevation on gunner's quadrant. Seats quadrant. Has assistant elevate or depress the tube until the quadrant bubble is centered. Calls "Ready" and waits for examiner to verify laying.
2----	QUADRANT 240-	Same as test 1 above.
3----	QUADRANT 205-	Same as test 1 above.

d. Penalties.

- (1) No credit will be allowed if, after each test—
 - (a) The quadrant elevation is set incorrectly.
 - (b) The quadrant is not properly seated.
 - (c) The quadrant bubble is not properly centered.

- (2) No credit will be allowed if the last movement of the tube was not in the direction in which it is most difficult to turn the elevating handwheel.

e. Credit.

Time in seconds, exactly or less than---	6	6%	7
Credit-----	2.0	1.5	1.0

15. Displacement Correction

a. Scope of Test. One test, consisting of two parts, will be conducted in which the candidate will be required to execute the commands given in *c* below.

b. Special Instructions.

- (1) Aiming posts will be set out at the prescribed distances.
- (2) An assistant, selected by the candidate, will be stationed close to the far aiming post.
- (3) The examiner will require the candidate to lay the piece on an announced deflection and report "I am ready."
- (4) The far post or the weapon will then be moved so that a displacement of 5 to 10 mils occurs.
- (5) The laying of the weapon at the termination of part I will not be disturbed for part II.

c. Outline of Test.

(1) *Part I.*

Examiner commands	Action of candidate
CORRECT FOR DISPLACEMENT.	Lays the piece so that the far post appears midway between the near post and the vertical crosshair of the telescope. Checks centering of bubble. Re-lays if necessary. Calls "Ready" and steps clear.

(2) *Part II.*

Examiner commands	Action of candidate
ALINE AIMING POST.	Records deflection on shield and announces "Deflection (so much) recorded." Directs assistant in alining aiming posts. Calls "Ready" and steps clear.

d. Penalties. No credit will be allowed if—

(1) *Part I.*

- (a) The far aiming post does not appear midway between the near post and the vertical crosshair of the telescope.
- (b) The cross-level or longitudinal-level bubble is not centered.
- (c) The last motion of traverse was not made to the right.

(2) *Part II.*

- (a) The deflection is other than the announced deflection.

(b) The aiming posts are not properly alined.

(c) The vertical hair of the telescope is not on the aiming posts.

e. *Credit.*

Part I, time in seconds, exactly or less than.	3	$3\frac{1}{3}$	$3\frac{2}{3}$	4
Credit	3.0	2.0	1.5	1.0
Part II, no time limit				
Credit	1.0	---	---	---

16. Measuring Site to Mask

a. *Scope of Test.* One test will be conducted in which the candidate will be required to execute the command given in c below.

b. *Special Instructions.*

- (1) The piece prepared for action will be placed 200 to 400 meters from a mask of reasonable height.
- (2) The tube will be pointed so that it is 100 to 150 mils above the crest and 100 to 150 mils right or left of the highest point of the crest.
- (3) The candidate will take post at the right rear of the breech.

c. Outline of Test.

Examiner commands	Action of candidate
MEASURE SITE TO MASK.	Sights along lowest element of bore and operates elevating and traversing mechanism until line of sight just clears crest. Sets angle of site scale at 300, centers longitudinal-level bubble by turning elevating knob, and and centers cross-level bubble. Reads elevation from elevation scale and micrometer. Reports "Number (so-and-so), site to mask (so much)."

d. Penalties. No credit will be allowed if—

- (1) The line of sight along the lowest element of the bore does not just clear crest.
- (2) The cross-level or longitudinal-level bubble is not properly centered.
- (3) The angle of site scale does not read 300.
- (4) The site is announced incorrectly.
- (5) The last movement of the tube was not in the direction in which it is most difficult to turn the elevation handwheel.

e. Credit.

Time in seconds, exactly or less than.

	11	12	13	14
Credit	4.0	3.0	2.0	1.5

17. Measuring Elevation

a. Scope of Test. One test will be conducted in which the candidate will be required to measure the elevation by means of the gunner's quadrant.

b. Special Instructions. Prior to the test the examiner will lay the tube at a selected elevation, measure the elevation, and then set the gunner's quadrant at zero.

c. Outline of Test.

Examiner commands	Action of candidate
MEASURE THE ELEVATION.	Places gunner's quadrant on quadrant seats of the breech ring. Levels bubble by raising or lowering the index arm and turning the micrometer knob. Announces "Number (so-and-so), Elevation (so much)," and hands quadrant to examiner.

d. Penalties. No credit will be allowed if—

- (1) The quadrant bubble is not centered when the quadrant is seated properly.
- (2) The elevation is announced incorrectly.

e. Credit.

Time in seconds, exactly or less than—	8	9%	10%
Credit -----	4.0	3.0	2.0

18. Measuring Deflection

a. Scope of Test. One test will be conducted in which the candidate will be required to measure and report a deflection in accordance with the command given below.

b. Special Instructions.

- (1) The piece will be laid on aiming posts to the left front.
- (2) An aiming point within 200 mils to the left

or right of the aiming posts will be designated by the examiner and identified by the candidate.

c. Outline of Test.

Examiner commands	Action of candidate
NUMBER (so-and-so), AIMING POINT, THAT (so-and-so), REFER.	Centers cross-level and longitudinal-level bubble. Refers to aiming point. Checks centering of bubbles and relays telescope if necessary. Reads deflection and reports, "Number (so-and-so) deflection (so much)" and steps clear.

d. Penalties. No credit will be allowed if—

- (1) The cross-level or longitudinal-level bubble is not centered properly.
- (2) The vertical hair of the telescope is not on the aiming point.
- (3) The deflection is announced incorrectly.
- (4) The traversing handwheel is turned.

e. Credit.

Time in seconds, exactly or less 5 5% 6 6%
than.

Credit..... 4.0 3.0 2.0 1.5

19. Test and Adjustment of Sighting and Fire Control Equipment

a. Scope of Tests. Six tests will be conducted in which the candidate will be required to demonstrate the methods employed in making the prescribed tests and authorized adjustments, or describe the action

taken (e.g., send to the ordnance maintenance company) if adjustment is not authorized to be made by using personnel.

b. Special Instructions.

- (1) The piece will be prepared for the tests as indicated in paragraphs 54 and 55 of this manual.
- (2) The equipment which will be needed for the tests is listed in paragraph 53 of this manual.
- (3) The candidate will select an assistant to operate the elevating handwheel at the direction of the candidate during tests 1 and 2 and adjust and aline the testing target at the direction of the candidate prior to test 5.
- (4) The tests will be conducted in the chronological sequence indicated in *c* below. After completion of test 2, the gunner's quadrant used in tests 1 and 2 will be used for test 3, with the proper correction as determined in test 1 carried on the quadrant, provided the correction does not exceed 0.4 mil.
- (5) Adjustments which the candidate may be required to accomplish will fall within the following limits:
 - (a) Elevation and angle of site scales, not to exceed one 100-mil graduation.
 - (b) Elevation and angle of site micrometer scales, not to exceed ten 1-mil graduations.
 - (c) Rotating head and telescope mount elevation indexes, none.

- (d) Rotating head and telescope mount elevation micrometer indexes, not to exceed one-fourth turn.
 - (e) Panoramic telescope azimuth scale, not to exceed one 100-mil graduation.
 - (f) Panoramic telescope slipping azimuth micrometer scale, not to exceed ten 1-mil graduations.
- (6) The tube will be leveled at the conclusion of test 2 and will not be disturbed thereafter.

c. *Outline of Tests.*

Test No.	Examiner commands	Action of candidate
1	PERFORM END-FOR-END TEST ON GUNNER'S QUADRANT.	Performs test as prescribed in paragraph 58 of this manual. Calls "Error (so many) mils, quadrant serviceable (unserviceable)" and hands quadrant to examiner for verification.
2	PERFORM MICROMETER TEST ON GUNNER'S QUADRANT.	Performs test as prescribed in paragraph 58 of this manual. Calls "Quadrant micrometer is (is not) in error."
3	TEST TELESCOPE MOUNT.	Performs tests and makes adjustments, if necessary, as prescribed in paragraph 54 of this manual. Calls "Cross (longitudinal-) level bubble(s) within (without) allowable limit."

Test No.	Examiner commands	Action of candidate
	Caution: Do not turn cross-leveling or elevation knobs of the telescope mount after this test.	
4	TEST RANGE QUADRANT. <i>Note:</i> Prior to test 5, the cross and longitudinal-leveling of the tube and the panoramic telescope mount will be verified by the examiner, and the testing target will be alined by the candidate with the help of his selected assistant as described in paragraph 54 of this manual.	Performs tests and makes adjustments, if necessary, as prescribed in paragraph 54 of this manual. Calls "Ready" and steps clear.
5	TEST ADJUSTMENT OF PANORAMIC TELESCOPE.	Performs tests and makes adjustments, as prescribed in paragraph 54 of this manual. Calls "Ready" and steps clear.
6	TEST ADJUSTMENT OF ELBOW TELESCOPE.	Performs test and makes adjustments, as described in paragraph 54 of this manual. Calls "Ready" and steps clear.

d. Penalties.

- (1) *General.* The tests are not essentially speed tests. The purpose of the prescribed time limits is to insure that the candidate can perform the operation without wasted effort.
- (2) *Test 1.* No credit will be allowed if—
 - (a) The bubble of the gunner's quadrant does not center when verified by the examiner.
 - (b) The error (one-half of the amount of the angle which was indicated when the quadrant was first reversed and the bubble centered by moving the index arm and micrometer) is announced incorrectly by the candidate.
 - (c) The candidate fails to declare the quadrant unserviceable if the error (necessary correction) exceeds 0.4 mil, or fails to declare the quadrant serviceable if the error (necessary correction) is 0.4 mil or less.
 - (d) The time to complete the test exceeds 2 minutes.
- (3) *Test 2.* No credit will be allowed if—
 - (a) The procedure is not followed correctly.
 - (b) The time to complete the test exceeds 1 minute.
- (4) *Test 3.* No credit will be allowed if—
 - (a) The bubble of the gunner's quadrant is not centered in either direction.
 - (b) The candidate does not announce correctly the status of either the cross-level or the longitudinal-level bubble.
 - (c) The matching indexes on the rocker and

actuating arm or those on the elevation knob and shaft are not in coincidence when the adjustments are complete.

- (d) The time to complete the test and adjustments exceed 4 minutes.
- (5) *Test 4.* No credit will be allowed if—
 - (a) The elevation micrometer does not read zero when the elevation scale reads zero.
 - (b) The angle of site does not read 300 when the cross-level and longitudinal-level bubbles are centered.
 - (c) The cross-level or longitudinal-level bubble is not properly centered.
 - (d) The time to complete the tests and adjustments exceeds 2 minutes.
- (6) *Test 5.* No credit will be allowed if —
 - (a) The candidate fails to make adjustments when such adjustments are indicated.
 - (b) The rotating head elevation micrometer indexes are not in coincidence.
 - (c) The zero line of either the azimuth scale or azimuth scale micrometer is not in coincidence with its respective index.
 - (d) The centerline of the bore, as viewed through the boresights, or the line of sight of the telescope does not fall on the respective sighting points on the testing target when all scales are set at zero.
 - (e) The time to complete the tests and adjustments exceeds 4 minutes and 30 seconds.
- (7) *Test 6.* No credit will be allowed if—
 - (a) The reticle is not horizontal.
 - (b) The “N” range line is not in coincidence

with the proper sighting line of the testing target.

- (c) The time to complete the test and adjustment exceeds 1 minute.

e. Credit.

- (1) The candidate will be scored on the general merit of his work in addition to the specific requirements above.
- (2) If the tests and adjustments are performed correctly within the prescribed time limits, maximum credit will be given as follows:

Test 1.....	2
Test 2.....	1
Test 3.....	2
Test 4.....	2
Test 5.....	2
Test 6.....	1
Total	10

20. Materiel

a. Scope of Tests. The candidate will be required to perform three tests as outlined below.

b. Special Instructions.

- (1) *Tests 1 and 2.* For tests 1 and 2, a paulin will be placed on the ground for the convenience of the candidate in laying out the disassembled parts. The candidate will be allowed to select the tools and accessories necessary for the performance of the tests prior to the start of the tests.
- (2) *Test 3.*
 - (a) A complete set of lubrication equipment authorized for use of battery personnel

will be made conveniently available on a paulin adjacent to the howitzer.

- (b) Every type of lubricant used on the weapon will be placed conveniently on the paulin, in plainly labeled containers.

c. Outline of Tests.

Test No.	Examiner commands	Action of candidate
1	DISASSEMBLE BREECH MECHANISM AND FIRING LOCK.	Performs the operation as described in TM 9-325, laying the parts on the paulin. After disassembly, identifies all parts to examiner.
2	ASSEMBLE BREECH MECHANISM AND FIRING LOCK.	Performs the operation as described in TM 9-325.
3	DAILY, WEEKLY, AND MONTHLY LUBRICATION TEST.	Selects proper lubricating equipment and lubricant and shows <i>how</i> and with <i>which lubricant</i> each lubrication point is serviced. (Actual lubrication is not performed.)

d. Penalties.

- (1) The tests are not essentially speed tests. The purpose of the maximum time limits is to insure that the candidate can perform the operations without wasted effort.
- (2) No credit will be given if the following time limits are exceeded :

Test 1	-----	1½ minutes
Test 2	-----	3 minutes
Test 3	-----	2 minutes

- (3) A penalty of one-half point will be assessed for each component part not correctly identified or omitted in test 1. There is no time limit imposed on the identification of component parts. However, the examiner may reduce the grade if it becomes obvious that the candidate is not familiar with the nomenclature.

e. Credit.

- (1) The candidate will be scored on the general merit of his work in addition to the specific requirements above.
- (2) If each test is performed correctly within the prescribed time limit, maximum credit will be given as follows:

Test 1	-----	3
Test 2	-----	3
Test 3	-----	4
		—
Total	-----	10

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[AG 353 (7 Sep 60)]		

By Order of *Wilber M. Brucker*, Secretary of the
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G. H. DECKER,
General, United States Army.
Chief of Staff.

Official:

R. V. LEE,
Major General, United States Army,
The Adjutant General

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For explanation of abbreviations used, see AR 320-50.

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FIELD MANUAL

105-MM HOWITZER M-2 SERIES TOWED

FM 6-75

CHANGES NO. 1

HEADQUARTERS,
DEPARTMENT OF THE ARMY
WASHINGTON 25, D.C., 15 May 1962

FM 6-75, 1 December 1960, is changed as follows:

Change figures 6, 9, and 13 to show the draw-bar body and lunette attached to the right trail of the howitzer.

Table I is changed as follows:

Number 2, sequence 3 (Superseded).

Assists number 6 in lifting and spreading the left trail when number 4 calls "spread."

Number 2, sequence 4 (Superseded).

When directed, removes the rammer staff from its traveling position, assembles it to the rammer head (bore brush), and assists number 1 in cleaning the breech mechanism, chamber, and bore.

Number 6, sequence 3 (Superseded).

Using the handspike for leverage, assisted by number 2, lifts and spreads the left trail when number 4 calls "spread."

Table II is changed as follows:

Number 2, sequence 2 (Superseded).

Using the handrail for leverage, assists number 6 in closing the left trail when number 4 calls "close."

Number 6, sequence 2 (Superseded).

Using the handspike for leverage, assisted by number 2, closes the left trail when number 4 calls "close."

19. To Couple

* * * * *

b. No 1, 2, 3, and 6 move to the trail handrails, even-numbered on the left, odd-numbered on the right with respect to the tube (fig. 11).

* * * * *

24. Gunner

* * * * *

b. *Lays the Piece for Direction.* The executive commands * * * azimuth micrometer scale. The gunner then commands MUZZLE RIGHT (LEFT) to aline the line of sight with the aiming point or instrument. If the line of sight is within 10 mils, the gunner may use the traversing mechanism to aline the line of sight with the aiming point or instrument. In either case, * * * READY FOR RECHECK. As additional deflections are announced (par. 48, FM 6-40), the gunner sets them off as described above. When the executive * * * point is fixed.

c. *Alines Aiming Posts.* With the piece * * * of the sight (fig. 23). If, because of the nature of

the terrain, the posts cannot be set out at deflection 2800, the gunner turns the azimuth micrometer knob until the nonslipping azimuth scale is on another even hundred-mil graduation. He alines the * * * verifies the adjustment.

* * * * *

27. Number 3

* * * * *

b. Sets the Fuze Using Setter M26 or M28.

* * * * *

- (2) Fuze setter M28 * * * seated on the fuze. No. 3 sets the fuze by placing the announced setting on the fuze setter and turning clockwise until the setter stops or a click is heard. He should then * * * the fuze setting.

* * * * *

31. General

* * * * *

b. (Superseded). The two basic systems of direct laying for use with the 105-mm howitzer are the *two-man, two-sight system* (pars. 35-39) in which the gunner, using the panoramic telescope, lays for direction, and No. 1, using the elbow telescope, lays for range (fig. 32) and the *one-man, one-sight system* (pars. 40-43), in which the gunner lays for both direction and range using the panoramic telescope. The *two-man, two-sight system* is faster and more accurate and permits the assistant gunner to check

the direction of lead. The *one-man, one-sight system* is less effective when the target is moving on a steep slope.

c. (Superseded). The *two-man, two-sight system* is the only effective system for engaging moving targets in all situations and should therefore receive greater emphasis in training. However, for emergencies, cannoneers should be familiar with the *one-man, one-sight system*.

* * * * *

34. Conduct of Fire

* * * * *

d. Ammunition and Fuses.

* * * * *

- (2) (Superseded) *Ammunition*. Ammunition may be HE, HEAT, white phosphorus (WP), or HEP-T M327. HEAT is designed for, and is highly effective in, antitank and antivehicle fires. HE is ideally suited for antipersonnel fire and is marginally effective against vehicles and tanks. WP may be used to set immobile tanks and vehicles on fire, to further restrict observation into defiles, and to produce casualties. However, consideration must be given to the effect of the resulting smokescreen on friendly forces. Shell HEP-T M327 is a thin-walled projectile with a plastic filler designed to be fired against slanted

surfaces of homogenous armor plate. It utilizes "Spalling" as a means of defeating armor.

* * * * *

35. Chief of Section

* * * * *

b. Identifies or Selects the Target. When the executive * * * identify his target. If the target is a group of tanks or other objects, the chief of section selects the target that, in his estimation, is the greatest threat to his own position or the position of the supported troops. The chief of section takes position to the flank and slightly to the rear of the piece so that his observation of the target will not be obscured by the effects of muzzle blast and smoke.

* * * * *

e. Gives Initial Command.

* * * * *

(3) *Lead.* The command is LEAD RIGHT (LEFT) (so much). See *d* above for the estimating.

* * * * *

(5) *Range.* The command is * * * the firing tables. By comparing the firing tables for shell HEP-T M327 and shell HEAT, a conversion table can be prepared for the use of shell HEP-T M327.

* * * * *

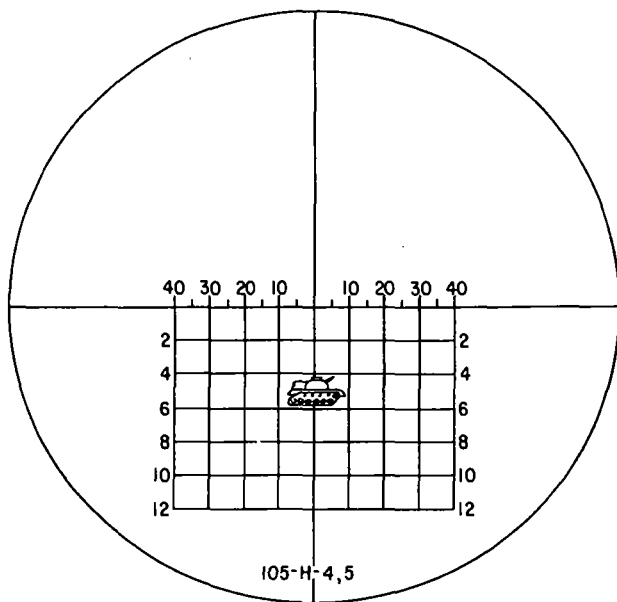


Figure 35. (Superseded) Gunners sight picture.

* * * * *

36. Gunner

* * * * *

b. (Superseded). Sets off announced lead on gunner's aid and tracks target.

- (1) Prior to any direct fire mission, the gunner zeros the nonslipping azimuth, the slipping azimuth, and the slipping micrometer scales.

(2) Sets off the announced lead on the gunner's aid and again zeros the micrometer scale.

(3) The operations in (1) and (2) above place the announced lead between the line of sight of the panoramic telescope and the axis of the bore. The gunner then tracks the target, using the traversing handwheel to keep the center vertical line of the telescope on the visible mass of the target (fig. 35). In the two-man, two-sight system, the vertical location (range) of the target is controlled by No. 1.

(4) If the chief of section does not announce a lead, it is estimated by the gunner.

c. (Superseded) *Commands FIRE*. After No. 1 has called "Set," the gunner, when he is ready, *withdraws his eye slightly from the telescope while still tracking the target and commands FIRE*.

* * * * *

37. Number 1 (Assistant Gunner)

* * * * *

c. *Calls "Set."* When the piece * * * piece is fired. To avoid eye injury, No. 1 withdraws his eye slightly from the elbow telescope but continues to track the target.

* * * * *

41. Gunner

* * * * *

c. Lays on the Target.

* * * * *

- (2) (Superseded). The reticle of the panoramic telescope is graduated for shell HE, charge 5. At ranges under 2,400 meters the elevations for charge 7 are almost half those for charge 5. Therefore, the reticle can be used for charge 7 by laying with half the true range. At ranges under 2,000 meters the elevations for shell HEP-T M327 are almost one-third those for charge 5, shell HE. Therefore, the reticle can be used for shell HEP-T M327 by laying with one-third the true range. When firing shell HEAT, the correct range setting is determined by the chief of section (par. 35e(5)).

* * * * *

59.1. Test of Azimuth Compensating Mechanism of Panoramic Telescope Mount

(Added)

a. General. The purpose of this test is to determine whether the azimuth compensating mechanism of the telescope mount actually keeps the tube in the correct vertical plane at all elevations. One of the tests listed in *b* and *c* below (in the order of preference) should be performed.

b. Test with Trunnions Level. Using the leveled trunnions and tube for control, this test determines whether errors exist in the actuating arm

pivot and/or level vials. Leveling may be accomplished by a plumbline check (par. 52d) or by cross-leveling with the gunner's quadrant on the breech ring. If cross-leveling is accomplished with the gunner's quadrant on the breech ring, results of the test are no more accurate than the parallel relationship of the trunnions to the top surface of the breech ring. Steps are as follows:

(1) *Cross-level test of telescope mount.* The telescope mount cross-level bubble must be in proper adjustment before the remainder of this test of the azimuth compensating mechanism can be conducted.

(a) Center the cross-level bubble and place the line of sight of the panoramic telescope on a sharply defined aiming point.

(b) Elevate the tube to maximum elevation while keeping the telescope mount level longitudinally.

Note. Do not readjust the cross-level bubble after the initial setting.

(c) The line of sight must not deviate from the target by more than 1 mil at any elevation checked nor may the cross-level bubble travel more than one-half vial graduation. If deviation in excess of the tolerance occurs, the level vial or pivot is incorrectly alined, and the weapon should be sent to an ordnance unit for adjustment.

(2) *Vertical alinement test of telescope mount.*

- (a) Level the tube longitudinally with the gunner's quadrant.
- (b) Center the longitudinal-level bubble.
- (c) Operate the cross-leveling knob throughout the limits of motion; the longitudinal-level bubble should remain centered within one-half vial graduation. If the bubble moves in excess of the tolerance, either the level vial or the actuating arm pivot is not alined correctly and the weapon should be sent to an ordnance unit for adjustment.

c. Test with Gunner's Quadrant on Socket. When the top surface of the socket is used for control, this test determines the relationship of the level bubbles to the top surface of the socket. If the socket is bent or if the top surface is not level, results of the test will be inaccurate. With the tube and trunnions approximately level, place a steel or glass plate having parallel sides on top of the telescope mount. Level the telescope mount both crosswise and longitudinally by turning the cross-leveling and elevation knobs, using the tested gunner's quadrant as a level. If the elevation indexes on the rocker and the actuating arm and those on the elevation knob and the shaft do not match, adjust them by moving the adjustable index on the rocker or by adjusting the elevation knob index as needed. If the cross- and

longitudinal-level bubbles are not centered within one-half vial graduation, adjustment must be made by ordnance personnel.

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For explanation of abbreviations used, see AR 320-50.

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